SEVENTH ANNUAL REPORT

OF THE

PENNSYLVANIA

DEPARTMENT OF AGRICULTURE.

PART I.

1901.

WM. STANLEY RAY,
STATE PRINTER OF PENNSYLVANIA.
1902.

VIRTUE LIBERTY AND INDEPENDENCE

PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

OFFICIAL LIST.

JOHN HAMILTON, *Secretary*,
State College, Centre County.

A. L. MARTIN, *Dep'y Sec'y and Director of Farmers' Institutes*,
Enon Valley, Lawrence County.

JESSE K. COPE, *Dairy and Food Commissioner*,
West Chester, Chester County.

BENJ. F. MacCARTNEY, *Economic Zoologist*,
Hamilton, Jefferson County.

LEONARD PEARSON, *State Veterinarian*,
Philadelphia.

M. D. LICHLITER, *Chief Clerk*,
Pittsburg.

GEORGE G. HUTCHISON, *Clerk, Dairy and Food Commissioner*,
Warriors' Mark, Huntingdon County.

FRANK S. CHAPIN, *Clerk, Economic Zoologist*,
Milton, Northumberland County.

LEWIS VANDERSLOOT, *Stenographer*,
York, York County.

GEORGE F. BARNES, *Messenger*,
Rossville, York County.

REPORT

OF THE

SECRETARY OF AGRICULTURE.

Harrisburg, Pa., January 1, 1902.

Hon. WILLIAM A. STONE, *Governor of Pennsylvania:*

Sir: In compliance with the requirements of Sections 2, 3 and 6 of the act of Legislature of March 13th, 1895, establishing this Department, I have the honor to present herewith my report for the year 1901, being the Seventh Annual Report of the Department of Agriculture of Pennsylvania.

The duties imposed by the laws of this State upon the Department of Agriculture are more comprehensive and varied than is generally understood. The undue emphasis that has been given by the public press to the law which protects butter from adulteration and fraudulent imitation has brought many to suppose that this, if not the only purpose, is at least the principal object for which the Department was established, whereas it is but one of many duties, equally as important and salutary, imposed upon the Department for fulfilment. The scope of the Department, as outlined in the act creating it, is as wide as the needs of agriculture. The law directs "That it shall be the duty of the Secretary of Agriculture, in such ways as he may deem fit and proper, to encourage and promote the development of agriculture, horticulture, forestry and kindred industries; to collect and publish statistics and other information in regard to the agricultural industries and interests of the State; to investigate the adaptability of grains, fruits, grasses and other crops to the soil and climate of the State, together with the diseases to which they are severally liable and the remedies therefor; to obtain and distribute information on all matters relating to the raising and care of stock and poultry; the best methods of producing wool and preparing the same for market, and shall diligently prosecute all such similar inquiries as may be required by the agricultural interests of the State

and as will best promote the ends for which the Department of Agriculture is established. He shall give special attention to such questions relating to the valuation and taxation of farm land, to the variation and diversification in the kinds of crops and methods of cultivation, and their adaptability to changing markets as may arise from time to time, in consequence of a change of methods, means and rates of transportation, or in the habits or occupation of the people of the State and elsewhere, and shall publish as frequent as practicable, such information thereon as he shall deem useful. In the performance of the duties prescribed by this act, the Secretary of Agriculture shall, as far as practicable, make use of the facilities provided by the State Experiment Station, the State Board of Agriculture and the various State and county societies and organizations maintained by agriculturists and horticulturists, whether with or without the aid of the State, and shall, as far as practicable, enlist the aid of the State Geological Survey for the purpose of obtaining and publishing useful information respecting the economic relations of geology to agriculture, forestry and kindred industries. He shall make an annual report to the Governor, and shall publish from time to time such bulletins of information as he may deem useful and advisable. Said report and bulletins shall be printed by the State Printer in the same manner as other public documents, not exceeding five thousand copies of any one bulletin.

"That it shall be the duty of the Secretary to obtain and publish information respecting the extent and condition of forest lands in this State, to make and carry out rules and regulations for the enforcement of all laws designed to protect forests from fires and from all illegal depredations and destruction, and report the same annually to the Governor, and as far as practicable, to give information and advice respecting the best methods of preserving wood lands and starting new plantations. He shall also, as far as practicable, procure statistics of the amount of timber cut during each year, the purpose for which it is used, and the amount of timber land thus cleared as compared with the amount of land newly brought under timber cultivation, and shall, in general, adopt all such measures as in his judgment may be desirable and effective for the preservation and increase of the timber lands of this State, and shall have direct charge and control of the management of all forest lands belonging to the Commonwealth, subject to the provisions of law relative thereto. The said Secretary shall also be and hereby is charged with the administration of all laws designed to prevent fraud or adulteration in the preparation, manufacture or sale of articles of food, the inspection, sale or transportation of the agricultural products or imitations thereof, and all laws relating to diseases of domestic animals, and to the manufacture and inspection of commercial fertilizers.

"That the Secretary may at his discretion employ experts for special examinations or investigations, the expenses of which shall be paid by the State Treasurer in the same manner as like expenses are provided by law, but not more than five thousand dollars shall be so expended in any one year."

To these duties thus prescribed, the Legislature has from time to time, by direct enactment, amplified their scope and added new items not originally included in the law.

The Legislature, in creating the Department, realized that the needs of agriculture are almost illimitable, that agricultural people have to do with soils, with crops of every kind, with animals and their products, with fertilizers, implements and machinery, contagious diseases among animals, insects, beneficial and injurious, fungous diseases among plants, forest growth and protection, the purity of food, soil moisture, roads, schools, taxes, etc.

Upon all of these subjects they need information, and it is made the duty of the State Department of Agriculture to furnish this information, so far as the discoveries of science and experience have made it possible.

They realized that the crying need of agriculture is for accurate information. Knowledge of the plants best adapted to the soil in each locality; what new plants can be profitably introduced; how the diseases that attack crops can best be controlled; how the insect enemies of plants can be restrained or overcome; what fertilizers can be used to best advantage in each locality; how tuberculosis, anthrax, black-leg and other diseases among domestic animals can be treated and prevented; what fruits are best to grow in the several districts; how forests may be preserved; how moisture sufficient for the growth of crops can be secured; the principles of taxation that should be adopted; how better roads can be built; how rural schools can be improved; how country children can be better educated; how local agricultural organizations can be made most useful; what additional legislation is needed for agriculture, and how it can be secured. The duty, therefore, of this Department is not only to carry into effect the laws committed to it for enforcement, but also to discover and disseminate truth in regard to all of the agricultural problems that arise.

It has been the aim of this Department to endeavor to fulfill these requirements, to discover the needs of agriculture and provide for their supply, to keep in touch with the best scientific and practical people, with the view of securing their assistance in the work of advancing the interests of agriculture in the State.

What has been done during the past year for the accomplishment

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What has been done during the past year for the accomplishment

of these purposes is partially shown in the following report, and in those of the Division officers incorporated herewith.

The past year has been one of the most abundant in agricultural products. There has been more than the ordinary amount of moisture and the rainfall has been pretty evenly distributed.

Some losses occurred in the eastern portion of the State from rain during harvest, but this was largely local. The prices of farm products were well maintained, and in some cases exceeded those of 1900. Corn, oats and potatoes were considerably higher than in the previous year, as were also horses and mules. There was a short crop of apples and pears. Prices, therefore, for these fruits were correspondingly advanced. Full reports of prices of farm crops and wages for each county in the State, are given in the report of the Deputy Secretary, and in the Appendix to this report.

FARM HELP AND WAGES.

Wages of farm help were higher than in 1900, and in some localities hands could not be obtained at any price. The great demand for labor by the building, transportation and manufacturing industries, has drained the rural communities of most of its efficient help, and has left the farmers to get through with their work as best they can. The farm labor problem has, therefore, become suddenly very serious. Fortunately agricultural machinery has reached such perfection, that one or two persons can now accomplish more upon a farm, than six or eight could perform years ago, and yet in some farm operations, as in the fruit-growing and dairy districts, much of the work must still be done by hand, and it is here that the lack of sufficient help is most severely felt.

If the present demand for labor in the manufacturing and other industries continues, land owners will be obliged to sub-divide their farms, reducing their size sufficiently, to make it possible for an ordinary family to perform the necessary labor without hiring additional help, except for a short time and only upon special occasions.

As labor becomes dearer, or which is the same thing, scarcer, farmers will have to adopt more economical methods in their business, and use their time to better advantage. Wherever possible, gang plows will take the place of the single plow, four horse harrows will supplant the two horse drag. The wider mowers, horse rake and drill will take the place of the present smaller sizes; horses will have to step more rapidly than now, less time will be wasted in going t

and from work, conveniences for watering, feeding and stabling of animals will be adopted, and each farmer will have to study his own peculiar surroundings and conditions and arrange his crops, his fields, his work, so as to do the greatest possible amount in the least possible time, and with the least expenditure of effort. In other words, the work will all have to be carefully planned in advance, and arranged with special reference to reducing the cost. This may be illustrated in the plowing of an acre of ground. The distance traveled is according to the width of furrow slice taken; an eight inch furrow will require twelve and one-third miles to plow an acre; a nine inch furrow, eleven miles; ten inch furrow nine and nine-tenths miles; eleven inch furrow nine miles, and twelve inch furrow eight and one-quarter miles.

The time required for plowing an acre, going at the rate of one and one-half miles an hour and cutting a nine inch furrow, will take seven hours and twenty minutes; one and three-fourths mile an hour will take six hours and thirty minutes; two and three-fourths miles per hour will take four hours, and three and one-half miles per hour will take three hours and eight minutes.

It has been shown by numerous experiments that it takes an average of thirty seconds to make a quarter turn in plowing. If the acre is one continuous furrow strip no time will be lost in turning. If it be half as long, two minutes will be lost; if one-quarter, four minutes; if one-eighth, eight minutes.

If it be in the form of a square and the furrow slice is ten inches wide, there will be 125.5 furrows, with four quarter turns for each time around, consuming two minutes to the round in turning, which represents a loss of four hours and eleven minutes in the plowing of an acre in that form.

These figures show the importance of close attention to what are commonly called little things. Instances of similar character could be multiplied, showing the losses that occur from inattention to the details of farming, and which cost the farmer much additional labor and expense.

The man who drives his cattle one-fourth of a mile twice each day to water has traveled, in forty years, 14,600 miles, and the man who pumps water for his cattle ten minutes three times a day will, in forty years, have lost two and one-half years of 300 days each out of his life.

The solution of the labor problem, therefore, although not wholly, is however to a far greater extent than is generally appreciated, in the hands of the farmer himself.

SUMMARY.

The work of the Department, as indicated in the former part of this report, is distributed among its various Divisions, and each Division, through its official head, is entrusted with the carrying out of all the details of the particular work assigned. The following summary shows the classification.

DIVISION OF FARMERS' INSTITUTES. The work of this Division is educational, carrying information to the districts in which the farmers' live, and reached during the past year about one hundred and fifty thousand farming people.

CROP REPORTS. The system of crop reports is made part of the work of the Institute Division. Careful reporters are engaged in collecting data for the Department in every county in the State. These data are then arranged and published in the Annual Report.

THE DAIRY AND FOOD DIVISION. This Division is under the immediate supervision and direction of a Dairy and Food Commissioner, who is charged with the enforcement of the laws relating to the inspection of the character of the various foods on sale in the State, and the prosecution of those who are found violating the law. The Commissioner has charge also of the Dairy industry of the State, including dairy statistics and improved management of creameries and dairy herds.

DIVISION OF ECONOMIC ZOOLOGY. This Division is in charge of a Commissioner who is known as the The Economic Zoologist, whose duties are to make examination and investigations into the insect enemies of crops and report upon their ravages and give suggestions for their control or eradication. There is assigned to this Division the Orchard, Greenhouse, Market Garden and Flower Gardening industries of the State. Information is sent out by him to those engaged in these industries, giving the latest scientific and practical discoveries in these lines of work, and as new questions arise he endeavors to have investigations made and proper solution discovered to meet the new conditions.

DIVISION OF VETERINARY SCIENCE. The chief of this Division is by law, required to be "a graduate of some reputable veterinary college." The law further makes it the duty of the Secretary of Agriculture "to obtain and distribute information on all matters relating to the raising and care of stock and poultry; the

best methods of producing wool and preparing the same for market." This work is consigned to the Veterinary Division. The Veterinarian is also a member of the State Live Stock Sanitary Board, whose duty it is to "protect the health of the domestic animals of the State," and powers to adopt means to effect this are granted by the act creating the Board.

FERTILIZER INSPECTION AND ANALYSES. The work of the licensing and inspection of Commercial Fertilizers is in the hands of the Secretary. Agents are employed to collect samples of goods upon the market, and these are transmitted to the chemists for analyses. The results are published for the information of farmers and dealers, twice each year.

INSPECTION OF NURSERIES. The Legislature of 1901 passed an act making it the duty of the Secretary of Agriculture "to cause an examination to be made each year of each and every nursery or other places in this State where trees, shrubs, vines or plants, commonly known as nursery stock, are grown for sale, for the purpose of ascertaining whether the trees, shrubs, vines or plants, therein kept or propagated for sale, are infested with San José Scale or other insect pest destructive of such trees, shrubs, vines or plants." Where a nursery is free from these insect pests, a certificate stating the fact is issued to the owner.

CONCENTRATED COMMERCIAL FEEDING STUFFS. Under the act of 25th of April, 1901, all concentrated commercial feeding stuffs sold in this State, such as "linseed meals, cotton seed meals, gluten meals, maize feeds, starch feeds, sugar feeds, dried brewers' grains, malt sprouts, hominy foods, cerealine feeds, rice meals, ground beef or fish scraps, and all materials of similar nature," must have affixed to the package containing them a label "certifying the number of net pounds of feeding stuff contained therein; the name, brand or trade mark under which the article is sold; the name and address of the manufacturer or importer, and a statement of the percentage it contains of crude fat and crude protein." The Secretary of Agriculture is charged with the enforcement of this law.

LINSEED OIL INSPECTION. The act of 23d of April, A. D. 1901, provides "That no person, firm or corporation shall manufacture or mix for sale, sell or offer for sale, under the name of raw linseed oil, any article which is not wholly the product of commercially pure linseed or flaxseed. Nor shall any person, firm or corporation manufacture or mix for sale, sell or offer for sale, under the name of boiled linseed oil, any article unless the oil from which said article is made, be wholly the product of commercially pure linseed or flaxseed, and unless the same has been heated to at least two hundred and twenty-five degrees, Fahrenheit." The Secretary of Agriculture is charged with the enforcement of this law.

SPECIAL INVESTIGATIONS. The law creating the Department provides for "the employment of experts to make special examinations and investigations." These experts are selected by the Secretary, and the results of their examinations are printed either in a special Bulletin or in the Annual Report. The investigations are upon subjects relating to the agricultural industry.

BULLETINS. The Secretary is also directed to "publish from time to time such bulletins of information as he may deem useful and advisable," "the number not to exceed five thousand copies of any one bulletin." Eighty-seven such publications have been issued since 1895.

ANNUAL REPORT. Each year the Secretary is directed to "make an Annual Report to the Governor," and in this report "he may include so much of the reports of other organizations as he shall deem proper." Thirty-one thousand six hundred copies are authorized to be distributed; 9,000 to the Senate, 20,000 to the House of Representatives, 2,000 copies to the Secretary of Agriculture, 500 copies to the State Librarian, and to the State Experiment Station, 100 copies.

BOOKS OF ACCOUNT. The General Books of Account of the Department are in charge of the Secretary, and the Special Books are in charge of the several Division officers.

REPORTS OF DIVISION OFFICERS. Monthly reports of the operation of each Division for the preceding month are made to the Secretary by the chief of each Division, and special reports from time to time are made as may be necessary in order to keep the Secretary fully informed as to the work of the several Divisions. At the close of the year, full reports of the work of each Division are made out and transmitted to the Secretary, and printed in the Annual Report of the Department. The care of the library, the reading of proof and the mailing lists are in charge of the Chief Clerk.

DIVISION OF FARMERS' INSTITUTES.

The work of the Department in educating the farming people of the State by means of the Farmers' Institutes is fully shown in the report of the Deputy Secretary, who is by virtue of his office, the Director of Institutes. The effects of an organized system for giving in-

struction in agriculture are now plainly seen in the improvement that has taken place in all sections of the State in agricultural practice.

Greater care is exercised in the collection and preservation of fertilizers, the cultivation of the soil, the selection of seed for crops, the manipulation of milk and the food articles manufactured from it, the health of animals, their food and shelter. Farmers are placing modern conveniences in their homes, adorning their grounds, improving their gardens and orchards and are giving more attention than formerly to the securing of better educational advantages for their children. The high character and qualifications of the lecturers employed by the Department to give instruction have greatly increased the interest of country people in the sessions of these meetings. The attendance is all that can be desired, for in most instances the meeting halls are filled. A comparison of the system adopted in Pennsylvania with those in use in other States satisfies us that we are not behind in this respect. Our system can be expanded indefinitely as the needs of the public demand more meetings and the finances of the Department justify. The work here, as in other sister States, is limited by our ability to secure a sufficient number of competent instructors to properly equip the several divisions. Men of mediocre attainments are of no use in this work. The teacher must speak with authority, and to do this he must know the truth of that which he asserts and its practical use in agricultural practice. Where to secure skilled teachers, is the problem that is now on us for solution. Some capable men are being developed each year, but the number is by no means sufficient to supply the demand. The Legislature added twenty-five hundred dollars per year to the Institute appropriation, making the sum now $15,000. Whilst this will enable the Department to add somewhat to the extension of the work, it will by no means meet the needs of the farming people in institute requirements. At least $25,000 per year should be devoted to this purpose; every dollar of this sum can be advantageously expended.

The Round-up meeting last June was one of the most interesting that has yet been held. These meetings bring the lecture force and the managers of institutes together in conference. The results are a better understanding of the needs of agricultural people and a more systematic and effective plan for supplying these needs. Before these round up meetings were held, each institute manager was compelled to solve all of the difficulties which he encountered, himself. Now these are presented before the meeting of managers from all over the State, and in almost all cases a satisfactory solution is found.

The lecturers also get to see what kind of work is demanded from them. They find that old worn out theories are not wanted, and

long-drawn out speeches, having but little of practical value to the farmer, are out of date. Bright, clean-cut and pointed talks, stated in an interesting way are now necessary.

For Institute purposes, the State has been divided into five sections. A separate set of lecturers is assigned to each section, and in a given county, the same Department workers continue until all the institutes in that county have been held.

The following distribution of time for holding institutes was made for the season of 1900-1901.

APPORTIONMENT FOR THE SEASON OF 1900-1901.

Section 1.		Section 2.		Section 3.		Section 4.		Section 5.	
COUNTY.	Days.	COUNTY.	Days.	COUNTY.	Days	COUNTY.	Days.	COUNTY.	Days.
Adams,	5	Blair,	4	Allegheny,	6	Bradford,	8	Bucks,	7
Bedford,	5	Columbia,	5	Armstrong,	5	Clinton,	3	Berks,	7
Chester,	7	Centre,	4	Butler,	6	Clarion,	6	Carbon,	2
Cumberland,	4	Clearfield,	4	Beaver,	4	Cameron,	3	Delaware,	4
Fayette,	5	Cambria,	4	Crawford,	8	Elk,	3	Lehigh,	5
Franklin,	5	Dauphin,	4	Erie,	6	Forest,	3	Luzerne,	4
Fulton,	3	Huntingdon,	4	Greene,	4	Jefferson,	4	Lackawanna,	4
Juniata,	4	Indiana,	6	Lawrence,	4	Lycoming,	5	Montgomery,	6
Lancaster,	9	Lebanon,	4	Mercer,	6	McKean,	4	Monroe,	4
Perry,	4	Mifflin,	3	Venango,	4	Potter,	4	Northampton,	5
Somerset,	5	Montour,	2	Washington,	5	Sullivan,	2	Philadelphia,	3
York,	8	Northumberland,	4	Westmoreland,	5	Tioga,	6	Pike,	2
		Schuylkill,	4			Warren,	4	Susquehanna,	6
		Snyder,	4			Wyoming,	4	Wayne,	6
		Union,	3						
	61		59		63		59		65

The apportionment shows the number of days that the Department agrees to furnish at least two lecturers to each county, for institute work during the season of 1900-1901. It is made on the basis of two days of institute to every county having not over 1,000 farms; three days to each county having more than 1,000 and not over 1,500; afterwards, one day for each 1,500 farms or fraction thereof additional. This insures Department aid to each county, in proportion to its agricultural interests.

THE DAIRY AND FOOD DIVISION.

The administration of the laws for the protection of the public against the sale of impure food, as will be seen from the report of the Dairy and Food Commissioner, has been attended with the same difficulties, that are usual in the enforcement of any law, that places restraint upon the natural desires of men, to realize large profits out of their business. The pressure of competition, in all lines of trade, is such as to compel business men, to exercise the greatest care in the management of their affairs, in order to succeed. Skilled experts are employed, to devise means for cheapening the production of goods already on the markets, and to discover new, and cheaper articles, which will imitate and undersell the old.

So long as these cheapening processes do not impair the quality, affect the healthfulness of the article, or deceive the purchaser, they are to be commended. But when, as not infrequently occurs, in the preparation of food products, the nutritive character of the article is weakened by the addition of cheaper substances, without notice to the public, or substances injurious to health are introduced, the law properly interferes to stop such practice, and to prescribe limits, beyond which the dealer shall not go.

The Dairy and Food Commissioner of this Department, is charged with the enforcement of certain laws, which protect the public against adulteration and fraud, in the preparation and sale of food products. As is stated elsewhere, in this report, the Department has endeavored to define, clearly, the requirements of these several laws, in order that there may be no excuse for their violation, on the ground of ignorance of their provisions. Those, therefore, who transgress in this respect, do so knowingly, and are, therefore, justly liable to pun

ishment for their violation. The exception to this, is on the part of a retailer, who has purchased goods of a manufacturer, supposing them to be made in compliance with the requirements of the laws of the State, but discovers later, that the goods are adulterated, and is arrested and fined for violating the law.

Where the manufacturer is outside of the State, the law cannot punish him, and if there were no other means of restraint, he would be free to sell any adulterated article he saw fit, without fear of arrest.

In the absence of a National pure food law, the only way by which he can be reached, is through the man who retails his goods within our borders. If the retailer understands that he will be held liable for the character of the goods he sells, he will protect himself, by requiring a sufficient guarantee from the manufacturer, to indemnify him against any loss that he may sustain, through failure of the goods to comply with the laws regulating the sale of food products in this State. This places the responsibility upon the manufacturer, where it properly belongs.

During the past year, important changes have been made in several of the pure food laws. An entirely new "oleomargarine" law has been enacted, with provisions added which, it is believed, will render its enforcement more effective, than was possible under the law which it repealed. Sufficient time has not yet elapsed, to fully test the new provisions, so that it is not possible, as yet, to state how the courts will construe them. The injunction clause, and the one which makes it the duty of courts to send the case to the grand jury upon representation by a constable, are the particular clauses which need to be tested.

The new "renovated butter" law is also quite different, from the old law, regulating this traffic. It is framed on substantially the same lines as the oleomargarine law, and its enforcement involves the same methods of procedure. Several suits have been tried under it which have terminated favorably. There are the "milk and cream adulteration" law, the amended "vinegar" and "cheese" laws, and the "fruit juice" law, all of which are committed to the Dairy and Food Commissioner for enforcement.

The work of enforcing these laws has been reasonably successful in all of the districts of the State, except in the County of Allegheny. The Dairy and Food Commissioner has treated, in his report, quite fully upon the condition in that county. The situation there can be summed up in a few words, namely, public sentiment in that county is against the enforcement of the pure food laws.

The situation is very grave, and its serious nature is not due to the mere item of the loss of certain cases by the State, but to the tem-

porary arrest of the power of the State, to enforce certain of its laws in that community, and from the fact that its agents, acting within the limits of the law which they are sworn to enforce, are punished for their faithful performance of this duty by having the costs of prosecution placed upon them to the extent of several thousands of dollars in a single court. If this action is to be accepted as a principle, controlling all prosecutions under State authority, then there will soon be an end of civil government in this country.

The details of this case are given in full in the report of the Dairy and Food Commissioner, and are well worthy of serious consideration.

RULINGS ON THE PURE FOOD LAW OF 1895.

The administering of the food law of June 26, A. D. 1895, prohibiting the manufacture, sale or offering for sale of adulterated food, defining the term "food," and declaring what shall be deemed an adulteration, has been attended with considerable difficulty, arising chiefly from difference of understanding in regard to the precise limitations of its requirements. In the absence of published rules, upon the various points covered by this act, manufacturers and dealers were largely in ignorance of the exact requirements of the Department, with respect to the various kinds of goods placed upon the market. Their anxiety was also increased because of the fact that any change in the officials having in charge the enforcement of the law, might result in the adoption of a different policy, which might greatly embarrass them in their business and occasion serious loss.

The experience of this Department during the seven years in which the law has been in operation in this State, together with that of officials having charge of the enforcement of similar laws in other States of the Union and in foreign countries, seemed sufficient to enable us to prepare a set of rulings that would cover all of the points in unmistakable language, and be legal in their requirements.

The adoption and publication of these rulings would place on record for the information of manufacturers and dealers, the exact present position of the Department, and would also be a guide for future officials, in their administration of the law, ensuring harmony of action during its future existence.

The collection of data for this purpose was begun over two years

ago, and the preparation of the rulings was undertaken about a year later. A meeting of all of the chemists and attorneys was called April 19th, 1901, to outline the work and prepare preliminary lists of points for consideration. Several other meetings were called later for the discussion of the items that had been prepared. Later still complete schedules were mailed to each of the chemists and attorneys for criticism, until at length in a general meeting the present rulings were adopted and have been published for the guidance of the agents, chemists and attorneys of the Department, as well as for the information of manufacturers and dealers.

The greatest care, therefore, was exercised in the preparation of these rulings and they are the result of the combined wisdom and experience of all of the officers of the Department, who have had experience in the enforcement of this law. This work of the Department has received the highest commendation from Dairy and Food Commissioners in other States and has had favorable criticism by distinguished health authorities in this State. There was some slight adverse criticism at the time of its publication by some who afterwards stated that they had not fully understood its scope. These rulings greatly simplify the work of the Department and enable the Dairy and Food Commissioner, his attorneys, chemists and agents to act in harmony, with perfect understanding of the provisions of the act which they are to enforce.

FOOD DEFINITIONS AND STANDARDS.

At the same time at which the subject of rulings under the food law of 1895 was being considered, the question of definitions and standards for the various foods was also taken up and a list proposed which has likewise been published for the information of the public.

These definitions and standards are classified under the several heads of Meats; Milk and Butter; Fruit Preparations; Saccharine Products; Spices and Condiments; Flavoring Extracts, and Table Beverages. By means of these definitions, manufacturers can see precisely what is regarded by the Department as constituting purity, without having to write to the Dairy and Food Commissioner each time that they may be in doubt. The publication of these standards has greatly relieved the Commissioner in this respect, and has proved

a great convenience to manufacturers in the preparation of their goods for sale in Pennsylvania.

The criticism has been made that these definitions and standards are purely arbitrary, and not having been enacted into law, have no standing in court and cannot be sustained.

Whilst it is true that the standards are not legal enactments, yet they are believed to be so manifestly conservative and acceptable in their requirements as to make it manifest to the courts, that articles represented to be pure which do not come up to their requirements are clearly below proper grade and are, therefore, inferior in quality, and to that extent, a fraud.

FOOD PRESERVATIVES.

In a recent bulletin issued by this Department, giving the chemists reports upon samples of food analyzed, attention is called to the fact that perhaps the greatest danger to the public that exists in the adulteration of foods, arises from the use of antiseptics or germicides for the preservation of perishable food substances. The use of these preservatives is such a convenient and cheap method of preventing decomposition, that manufacturers and dealers are tempted to take advantage of their existence and dose their food preparations, until the public is, unconsciously, being medicinally treated by a class of manufacturers who are either ignorant of the physical effects of these preparations, or else are regardless of their consequences upon the health of an unsuspecting public. Milk, butter, oysters, mince meat, ham, bacon, canned meats, sausage, bologna, cider, catsup, fruit juices, jellies, jams, marmalades, canned fruits and vegetables are all liable to be adulterated with one or more chemical preservatives, such as sulphurous acid, benzoic acid, salicylic acid, formaldehyde, borax, etc., in their various forms.

The following table, by T. Lauder Brunton, taken from Pharmacology and Therapeutics, 91, will give some idea of the relative value, as antiseptics, of some well-known substances, of which it will be seen that the violent poison, Corrosive Sublimate, is by far the strongest:

	Proportions of Antiseptic to Mediums Required.	
	To kill developed bacteria.	To prevent the development of spores in boiled meat infusions.
Corrosive sublimate,	1: 5805	1: 10250
Sulphurous acid,	1: 2009	1: 8515
Benzoic acid,	1: 410	1: 2877
Salicylic acid,	1: 60	1: 3003
Borax,	1: 48	1: 30

The attitude of Hygienists in regard to the indiscriminate use of certain preservatives in food, can be seen from the reports of the proceedings of their meetings, wherever the subject has been discussed. The following extracts from leading authorities in England and the United States, express the views of these eminent men, and show that there is no essential difference of opinion among them as to the harmfulness of chemical preservatives, indiscriminately used, upon the public health.

"At the meeting of The Sanitary Institute Congress, held at Birmingham, Sept. 27-30, attended by 1,979 members, the president of the Sanitary Science Section, Dr. Alfred Hill, M. O. H., Birmingham, in his address 'drew attention to the enormous use of food preservatives. Many of them had uncertain physiological effects. After reviewing various methods of preserving food—such as by dry heat, salt, sugar, etc.,—he referred especially to the more modern methods of adding chemical substances, such as boric acid, borax, salicylic acid and formaldehyde. For the preservation of milk, butter, cream and meat, boric acid was principally and very largely used. It had been shown that borax was fatal to the lower animal and vegetable organisms, and he contended that it was also injurious, if not fatal, to higher organisms. Although some authorities argued that the small quantities in use as preservatives could not be prejudicial to the human organisms, they overlooked the fact that at present there was no limit to the quantity which might be added. He wished to point out practically that several individuals might add a small quantity successively, so that the resulting amount might be sufficient to cause an increased secretion from the intestines, with serious diarrhoea as a consequence. Opinions of experts, such as Drs. Stevenson and Luff were quoted to show that the precise amount which might

be added and yet be harmless had not yet been determined, while the notions of food purveyors were much too indefinite to be safe.' THE ONLY PROPER COURSE THEN WOULD BE TO PROHIBIT THE USE OF SUCH SUBSTANCES ALTOGETHER."

"Dr. Fosbroke (Worcester C. C.), in moving a vote of thanks to the President, said 'that he looked upon boric acid in some respects as he would arsenic, namely, as useful in small amounts and in skilled hands only. It should never be given as a preservative to children and invalids.' "—British Medical Journal, Oct. 8, 1898.

The following resolutions by the Incorporated Society of Medical Officers of Health sustain the above view. The British Medical Journal of 1899, page 1071, in reporting upon the meeting of the Medical Officers of Health, states as follows:

"Dr. A. Hill read a paper before the Society of Medical Officers of Health, April 14, 1899, on the 'Use of Antiseptics in Foods.' "

After the discussion the following resolutions were passed, almost unanimously:

1. "Resolved, That the Incorporated Society of Medical Officers of Health strongly disapproves of the practice of adding preservative chemicals to milk and other foods.

2. "That if preservative chemicals are added to any food, a full disclosure as to the nature and amount thereof should be made to the purchaser."

In the British Medical Journal of August 18, 1900, Albert S. Grunbaum, M. D., D. P. H., says:

"If we could rely on the quantity and quality of a preservative being always intimated to the purchaser, it might be possible to permit its use within certain limits, but I see no hope of inducing the trade at large to do so. * * * For most articles of food the addition of preservatives should be uncompromisingly forbidden. * * * We should use the experience already gained in surgery. Asepsis now rules instead of antisepsis, and what we require is aseptic not antiseptic food. Two physical means are at our command for this purpose—heat and cold."

In the discussion that followed, Dr. Walsh stated, that "without a more accurate knowledge of the effect of these preservative drugs on the human system, we lacked data on which to found legislation. In the present transition stage, Dr. Grunbaum's insistence upon asepsis as against antisepsis of food was the most practical contribution yet made on the subject."

The Mason Committee appointed by the United States Senate had before it experts upon food adulteration, who testified as to the propriety of the use of antiseptics in foods.

The "Journal of the Americal Medical Association," published the following comment upon their sessions held in Chicago:

"The recent session held in Chicago by the Committee appointed by the United States Senate to investigate the adulterations of food, furnished a splendid opportunity for the ventilation of the entire food question, and especially that phase of it pertaining to the use of preservatives. Seldom have so many chemists of undoubted experience and reputation uniformly and unequivocally agreed to a question upon which there was generally supposed to be a decided difference of opinion. The witnesses called to testify because of their experience in the examination of food and their adulterations, comprised Dr. W. T. Wiley, Chief Chemist to the Department of Agriculture, Washington; Dr. A. S. Mitchell, Chemist to the Davey Commission of Wisconsin; Professor A. B. Prescott and Professor Victor C. Vaughn, of the University of Michigan, and Professor C. S. N. Halburg, of the School of Pharmacy of the University of Illinois. Every one of these gentlemen laid down the principle *that the addition of any substance which will retard or prevent fermentation or other change of decomposition in food or food products in its preparation or preservation, will also retard, impair or prevent the changes of decomposition upon which the digestion and consequent assimilation depend, and to that extent interfere with nutrition.* This is the broad principle, and, measured by it, all antiseptics, antiferments or other preservative agents of this character, such as salicylic acid and other phenol derivatives, boric acid, formaldehyde, &c., should be relegated to performing their original function, namely, the paralyzing of pathogenic bacteria in surgical operations and on the cadaver, and not for ingestion in the healthy human stomach, except for intestinal antiseptics and similar therapeutic purposes. Yet there is no principle, perhaps, without an exception, and such seems to be the case here. Some of the experts believed that there was a legitimate use for antiseptics, or, rather, antiferments, in that class of food preparations called condiments. Thus it was pointed out that catsup could not be preserved for a desirable length of time in the average household without the addition of some preservative. Since the quantities used of such articles by each individual is comparatively small, no harm could arise from the employment, within certain defined limits, of a preservative agent in this instance. With less force may the same limitation be applied to the preservation of certain saccharin beverages, although the more largely used of these—such as beer—require no addition for their preservation—heat and refrigeration alone. The additions are, moreover, objectionable, from the fact, as pointed out by Professor Prescott, that their use facilitates the sale of foods which otherwise would be rejected on account of its apparent inferior quality or liability to spoil; also, according to Dr. Vaughn, in that the antiferments are employed in lieu of, or to cover up, defective or otherwise faulty sterilization and, possibly, refrigeration."

The most extended and thorough investigation into the use and effect of preservatives and coloring matter in foods is that which has recently been completed by an English Departmental Committee, whose report and recommendations have been presented to Parliament for consideration. The Committee was appointed in July, 1899, by the Hon. Henry Chaplin, President of the Local Government Board of England, and consisted of Right Honorable Sir Herbert Eustice Maxwell, Bart., M. P.; Prof. Thomas Edward Thorpe, Vice President of the Royal Society; Henry Timbrell Bulstrode, Esq., M. D.; and Francis Whittaker Tunnicliffe, Esq., M. D.

"To be a Committee to inquire into the use of preservatives and colouring matters in the preservation and colouring of food, and to report:

1. "Whether the use of such materials, or any of them, for the preservation and colouring of food, in certain quantities, is injurious to health, and if so, in what proportion does their use become injurious.

2. "To what extent, and in what amounts, are they so used at the present time."

During the two years and more of the existence of this Committee they held meetings upon twenty-six days, during which they examined seventy-eight witnesses. Their report includes the testimony of these witnesses and embraces over 500 quarto pages.

The Committee after discussing the testimony at considerable length presented their conclusion in the following set of recommendations.

Recommendations.

(A.) "That the use of formaldehyde or formalin, or preparations thereof, in foods or drinks be absolutely prohibited, and that salicylic acid be not used in a greater proportion than 1 grain per pint in liquid food, and 1 grain per pound in solid food. Its presence, in all cases, to be declared.

(B.) "That the use of any preservative or colouring matter whatever in milk offered for sale in the United Kingdom be constituted an offense under the Sale of Food and Drug Acts.

(C.) "That the only preservative which it shall be lawful to use in cream be boric acid or mixtures of boric acid and borax, and in amount not exceeding 0.25 per cent. expressed as boric acid. The amount of such preservative to be notified by a label upon the vessel.

(D.) "That the only preservative permitted to be used in butter and margarine be boric acid or mixtures of boric acid and borax, to be used in proportions not exceeding 0.5 per cent. expressed as boric acid.

(E.) "That in the case of all dietetic preparations intended for the use of invalids or infants, chemical preservatives of all kinds be prohibited.

(F.) "That the use of copper salts in the so-called greening of preserved foods be prohibited.

(G.) "That means be provided either by the establishment of a separate Court of Reference or by the imposition of more direct obligation on the Local Government Board, to exercise supervision over the use of preservatives and colouring matters in foods, and to prepare schedules of such as may be considered inimical to the public health."

HERBERT MAXWELL, Chairman.
T. E. THORPE,
H. TIMBRELL BULSTRODE,
F. W. TUNNICLIFFE,
CHAS. J. HUDDART, Secretary.

The high character of this commission makes the report of unusual value and entitles their recommendations to most respectful consideration.

The committee in effect excludes all chemical preservatives from food, except salicylic acid and borax or boric acid. It confines the use of borax or boric acid to cream and butter. When used in cream, not more than 0.25 per cent. is permitted, expressed as boric acid, and the amount to be stated on the label. When borax is used, in butter, not more than 0.5 per cent. shall be used, expressed as boric acid. When salicylic acid is used in any food, not more than one grain, per pint, shall be allowed in liquid food, and not more than one grain, per pound, in solid food, its presence to be declared.

The testimony before the committee was overwhelmingly against the use of any and all chemical preservatives in food. The Society of Medical Officers of Health appointed two delegates to appear before the Commission who were both opposed to the use of preservatives and also presented the following resolutions from the Society:

"The Society strongly disapproves of the practice of adding preservative chemicals to milk and other foods. That if preservative chemicals are added to any food a full disclosure as to their nature and amounts should be made to the purchaser."

The evidence of the physicians and surgeons is summed up in the following statement by the Committee: "In so far, however, as expressions of opinion went, the profession was almost unanimous in its condemnation of the present unrestricted use of preservatives.

"The medical profession was clearly impressed with the importance of at least intimating, by a system of labeling, the nature and, where practicable, the amount of the preservative used.

"In the opinion of Sir Lauder Brunton and other witnesses, it is a serious matter that a medical man should prescribe a daily dose of any drug to a patient who may, unknown to himself and the physi-

cian, be consuming an indefinite quantity of the same drug in his food. * * * * They were of the opinion that there are certain conditions of human economy in which the administration of drugs, such as boric acid and salicylic acid, are held to be contra-indicated. Among such conditions specific reference was made to inflamatory states of the kidneys, certain states of the digestive tract, and of the reproductive organs.

"It was pointed out by several witnesses that, inasmuch as certain of these conditions are likely, in the aggregate, to be of considerable prevalence, it is a matter of importance that persons suffering from such conditions should be protected from the danger to which the unregulated use of drugs might conceivedly expose them."

The evidence of the Physiologists and Pharmacologists is also stated by the Committee in the following language: "It may be said at once, that all of these witnesses strongly deprecated the unregulated use of preservatives, at least those at present known. * * * The a-priori objections of physiologists, to certain preservatives and colouring matters, also rested upon the fact, that they are foreign to the animal body, and that the continued ingestion of these, could not be treated with indifference."

Notwithstanding these strong declarations by these several classes of expert witnesses against the use of chemical preservatives, the Committee have, nevertheless, allowed the restricted use of salicylic acid and borax.

The fact that the Committee prohibits all use of preservatives in milk, and in food for invalids and infants, is an admission that they recognize their possible harmful character. There is no definition, as to what constitutes an invalid, in the sense of liability to injury, from the use of these drugs. Any one is an invalid, so far as necessity for care in diet is concerned, whose digestive organs are weak, or whose idiosyncrasy is such as to render him easily susceptible to the influence of certain drugs; and since the great majority of people are affected in one or both of these ways, the only logical and safe course, so far as protection of the public health is concerned, would manifestly have been to have prohibited the use of these preservatives in all foods.

But the Committee, evidently, felt that they were limited in the application of this safe rule, by the peculiar commercial conditions that exist in England, and they hint at this in the following statement, taken from their report:

"It should be borne in mind that under the conditions in which the population of Great Britain lives, and more particularly that portion of it inhabiting the large towns, some preserving agent, not necessarily chemical, appears to be needed in the case of no inconsiderable portion of its perishable food supply. It is common knowledge that

the food producing capabilities of this country do not suffice in all particulars for the needs of its population. Under these circumstances the total prohibition of preserving methods would clearly be likely to be attended with serious results to the public health, in that large quantities of food possessing highly nutritive value might in effect either be withheld from the poorer classes, or be liable to be consumed by them in a condition of incipient putrefaction."

In other words, owing to the fact, that Great Britain is compelled to import from distant countries much of her perishable food supply, therefore, she is, in a sense, compelled to permit the limited use of some preservative, believed by the medical profession to be injurious to health, as the least of two evils.

That this a fair presentation of their attitude, is shown from their permission of the use of boric acid in cream, but not in milk. Of milk they have a sufficient supply, but not of cream. I quote the statement of the Committee:

"In regard to cream, the question is somewhat different. We are of opinion that, *under present conditions*, it would be difficult to maintain or increase the present supply of cream, without the use of some preserving agent. The presence of some preserving agent is *less objectionable* in cream than in milk, because cream is usually consumed in much smaller quantities than milk; but inasmuch as cream is now often prescribed for invalids and children instead of cod liver oil, *we consider that the obligation should be laid on the vender of cream of notifying the presence, nature and quantity of the preservative.*"

The present conditions that exist in Great Britain, do not exist in the United States. We supply ourselves with these articles of food, which the British people find it necessary to import, consequently we are in position to insist that the foods offered in our markets shall all be pure, not only such as are to be offered to the unfortunates, who from inheritance or indulgence have weak digestions, but to all of our people irrespective of their physical condition.

If the Commission had been dealing with conditions, such as obtain in Pennsylvania, it would, unquestionably, have prohibited the use of chemical preservatives, without exception.

The declaration of the high authorities, whose testimony and conclusions I have quoted at some length, should, in the absence of positive evidence of the harmlessness of any particular antiseptic or food preservative, have great weight in controlling the action of the food authorities, who are entrusted with the enforcement of laws, for the protection of the public health. It certainly is the duty of these officials, to construe the laws as strictly as their provisions warrant, rather than by a too liberal interpretation, to throw open the markets, to foods drugged by dealers who know nothing of the effects of

these chemicals upon the physical system, and whose only interest is a purely selfish and mercenary one, namely, to secure their preservation until they have been able to dispose of them at a profit, utterly careless of what may be the results of their use, upon the public health.

The following summary, taken from "The Law and Chemistry of Food and Drugs," edited by H. Mansfield Robinson, LL.D., and Cecil H. Cribb, F. I. C., Fellow of the Chemical Society, gives in brief form, some of the reasons, why Food Commissioners are under obligation to exercise great caution in permitting the use of antiseptics in food.

The reasons here given for restricting, if not prohibiting, the use of preservatives in food, will commend themselves to every unprejudiced citizen:

(1) "*With regard to medical evidence.* It is unnecessary to prove that preservatives are in all cases injurious. Under certain conditions even violent poisons fail in their action, and one instance of harm having resulted from a food preservative has infinitely more weight than numerous cases where large, perhaps enormous, doses have been taken with no ill effect.

(2) "*The fact that the quantities used are small has no bearing on the matter.* The constant repetition of a small dose may produce effect, when a single administration of the same quantity would utterly fail to do so. Moreover, any quantity, enough to act as a preservative, is likely to be enough to do harm; for it is difficult to conceive, that a drug which will affect the protoplasm of such hardy organisms as bacteria, can be without influence on the delicate mucous membrane of the stomach and other parts of the alimentary canal.

"(3) *None of these preservatives is a food*, or a natural constituent of food, neither do they enter into the formation of any part of the animal body.

"(4) *On the other hand, they are drugs*, and are used in medicine for certain definite purposes. It is absurd to forbid pharmacists to prescribe, and at the same time to allow the butcher, the brewer and the butterman to dose the general public without their knowledge or consent.

"(5) *They are not really necessary.* There are legitimate methods of preservation which do not involve the use of drugs, such as sterilization by heat and subsequent packing without access to germ-laden air; or by refrigeration, which, so long as it is continued, renders fermentation impossible. In many cases, some natural constituent of the article has more or less marked antiseptic properties; e. g., the sugar in jams and condensed milk, the salt in butter, and pepper in sausages.

"(6) As long as their employment is allowed, there will always be

the danger of its being for other than the legitimate purpose, i. e., *to conceal incipient putrefaction, and to enable stale goods to be palmed off as fresh.*"

The position occupied by the Department of Agriculture in this State is perfectly clear, and altogether just, both to the public and the manufacturer and dealer.

After a most careful investigation of the entire subject of food preservatives, the Department last summer prepared and published a set of rulings, one of which is the following declaration, relating to preservatives in food, known as Rule 12: *Articles of food that can be prepared by the use of improved processes, so as to preserve them from decay and change, shall have no preservatives added, other than salt, syrup, sugar, saltpetre, spices, vinegar and wood smoke.*"

This rule requires that a manufacturer who wishes to use a preservative other than those indicated, shall first show that the article to be preserved cannot be kept without the use of a preservative; and he must then show, that the particular preservative which he proposes to use, is not injurious to the public health. He must show, not simply that it has no appreciable injurious effect upon a healthy and vigorous man, but that it has no harmful effect upon delicate digestion, in either adult or infant. The importance of the public health is paramount. The legal maxim is as true to-day, as in the age when first announced: "*That the safety of the people is the supreme law.*" "In default of law the maxim rules."

If drugs are to be administered, their prescription should be confined to skilled physicians, who administer them for specific purposes, and discontinue their use as soon as these purposes are accomplished. But for butchers and bakers, canners and packers, grocerymen and dairymen to assume such responsibility, and indiscriminately dose their unsuspecting customers with harmful chemicals, to the jeopardy of health, ought not to be tolerated.

DIVISION OF ECONOMIC ZOOLOGY.

The work of this Division, during the year, is summed up by the Economic Zoologist, whose statement is presented in full, in another part of this report.

The field embraced by this Division is enlarging each year, and the necessity for expert investigation, in the discovering and application

of proper means for the control of injurious insects, is greater now than ever before. We find, on the other hand, that the number of persons educated in this direction is so small, that it is extremely difficult to secure the services of men competent for the work. The future development of the fruit industry in this State is seriously threatened by the presence of insects, whose destructive power has been fully demonstrated.

The Curculio, the Apple and Peach Tree Borer, the Black Wooley Aphis, the Tent Caterpillar, the Grain Moth, the Hessian Fly, the Army Worm, the Gypsy Moth, the Chinch Bug, the San José Scale and a multitude of other insects, the control of which is not yet complete, furnish a field for investigation that is of incalculable moment to the grower of crops.

Prof. E. Dwight Sanderson, of Delaware, in a recent publication, states that the loss in the United States from injurious insects amounts to at least three hundred millions of dollars annually. In other words, that one-tenth of the entire agricultural product of the country is lost, each year, through the depredations of insects. For the discovery of instruments of warfare sufficient to overcome these myriads of devastators, agriculture must look to science.

The country is annually expending millions upon millions of its income in efforts to discover and perfect more deadly weapons for the destruction of men, who threaten our institutions and welfare. A like liberal appropriation would not be out of place, for the discovery of appliances for the protection of the country against insect enemies, equally injurious and equally to be feared.

The Department made an effort last winter to have added to its appropriation a small sum for the work of this Division, but failed to convince the Legislature of its necessity, and the measure failed.

Some work has, however, been undertaken for the discovery of the period of activity of the Hessian Fly in the various sections of this State, and the services of a skilled entomologist have been secured for this work. Many thousands of samples of growing grain have already been received from all sections of the State, and examined for the presence of the larva of this insect. The investigations will occupy at least a year, and perhaps three or four years, before sufficient data can be secured to justify the offering of advice which can be relied upon as being safe to follow.

The Department, also, prepared a bill which was presented before the last Legislature, and passed, which provides for the inspection of nurseries throughout the State for the presence of San José Scale and other injurious insect pest or pests. An inspector was appointed, who has been all over the State during the past autumn, having visited one hundred and thirty-one nurseries, embracing an area of two thousand three hundred and fifty-seven acres. The details of

his work are given in the report of the Economic Zoologist, before referred to.

An important convention of official Horticultural Inspectors for the United States and Canada, was held last November in the city of Washington, D. C.

These inspectors are charged by their respective States with the inspection of orchards and nursery stock, for the purpose of discovering whether or not, any injurious insect pest or pests are present, and to prescribe treatment for their eradication or control.

At this meeting, which was composed of the leading entomologists of the United States, men who have had extended practical experience in dealing with insect pests, but who nevertheless differed from each other in their methods of procedure for their control, the writer offered the following resolution, which was adopted:

"Resolved, That in order to arrive at a common understanding as to the best insecticides to use for the destruction of San José Scale in the orchards and nurseries of this country, and in order to secure definite directions for their application, a committee consisting of Messrs. Smith, of New Jersey; Webster, of Ohio; Fernald, of Mass.; Alwood, of Virginia, and Atwood, of New York, is hereby appointed to prepare a recommendation to this association for its consideration."

At a later session the above committee presented the following report, which was adopted:

"The committee, after due consideration, finds itself able to agree upon the following recommendations for treatment:

1. For nurseries: Proper fumigation with hydrocyanic acid gas after inspection.

2. For orchards: Late summer and fall treatment with dilute solutions of insecticide soaps, oils or other effective insecticides to kill young scales. Winter treatment with insecticide soaps or oils sufficiently strong to kill the scale, and which have been proved safe to trees of all kinds in the region where the application is to be made."

The guarded nature of the statements in this report, made by the leading authorities in the United States upon this subject, shows how undecided even our best equipped scientists are as to the best methods to adopt for resisting these insect foes.

The need, therefore, for a liberal appropriation to continue investigations along these lines is manifest to any one who has given even slight attention to the subject.

FORESTRY DIVISION.

The last Legislature after careful consideration of the needs of the State in the matter of acquiring control and the subsequent management of forest lands, passed an act taking the Division of Forestry from the Department of Agriculture and erecting it into a separate department of the State government.

The problem of forest management suited to American conditions is comparatively new, but I am confident that it will be properly solved by those who have the responsibility for its solution.

I wish to here record my personal appreciation of the ability and courtesy of the gentleman who was formerly chief of this Division in the Department of Agriculture, and who now has been advanced to the head of the new Department of Forestry in this State.

DIVISION OF VETERINARY SCIENCE.

The report of the State Veterinarian gives in detail the important work of this Division in connection with the State Live Stock Sanitary Board. The report shows that a large number of trained scientific men are now engaged, both in this country and in Europe, in the investigation of the causes of the diseases that attack domestic animals, and in discovering remedies for these diseases and preventive methods for the protection of healthy herds.

Much light has been thrown on the origin of diseases by recent wonderful discoveries in the realm of germ life, or more specifically, that of bacteriology.

The organisms that produce certain diseases are now known and easily recognized, and in quite a number of instances the means for their destruction or control have been discovered. The germs of anthrax, tuberculosis, glanders, tetanus, cholera, typhoid fever, diphtheria have been isolated and their action in attacking the animal organism fairly well understood.

Remedies of greater or less efficacy have been discovered, and results reasonably satisfactory have attended their application.

The report of the Veterinarian shows that the Department of Agriculture of Pennsylvania is not behind in the work of investigation in this direction. The Bacteriological Laboratory of the State Live Stock Sanitary Board, which is practically a part of the Division of Veterinary Science of this Department, has been doing a large amount of valuable work. Expressions by individual members of the recent congress of scientists, held in London, show that Dr. Ravenel, the Bacteriologist in charge of this laboratory, stands at the head of his profession, in his investigations into the interchangeable character of the germs of tuberculosis as between man and domestic animals. His paper read before that congress, giving the results of his experiments, and printed in another part of this annual report, shows that there is at least a strong probability that such interchangeability is possible.

The report of the Veterinarian makes clear the fact that we have in certain localities in our midst, the germs of diseases most dangerous and destructive to domestic animals, and that these germs, if uncontrolled, will speedily spread and do incalculable damage to the live stock of the State.

The Veterinary Division, therefore, stands between these infested or infected localities and the balance of the State, confining, so far as possible, each outbreak to the immediate vicinity of its origin. What the State has gained by this vigilance, and skilled and prompt treatment of contagious diseases, it is of course impossible to accurately estimate, but that its value is very great can easily be understood, when it is known that the sale of a single diseased herd has spread infection far and wide and has resulted in the loss of many times the original number. The work of this Division is, therefore, most important to the live stock breeders and owners of the State, and its efforts to suppress the spread of contagious diseases should be encouraged by all who have the welfare of the Commonwealth at heart.

As is the case in all of the other Divisions of the Department of Agriculture, the work in this Division is also scientific in its character, and none but the most skillful should be employed in the administration of its affairs.

To ensure a supply, for the future, of competent men in this work, I repeat the recommendation made in my last report, that opportunity should be given and inducements offered to young veterinarians of ability to work in the laboratory of the Board, gradually increasing their compensation as they develop in skill, until they shall prefer to continue in the service of the State, rather than engage in private practice. If young men could be assured of permanence in such employment, the State in future years would be distinguished because

of its advanced position in the development of agriculture, through the work of the skilled scientists in her employ.

The work of this Division is so fully set forth in the report of the Veterinarian, that it is unnecessary to do more here than direct attention to it without repeating its statements.

COMMERCIAL FERTILIZERS.

It is the duty of the Secretary of Agriculture "to collect samples of commercial fertilizers; to have them analyzed, and to publish the results for the information of the public." During the past year there have been two bulletins issued by the Department, giving the results of analyses of fertilizers, one giving the results of analyses of samples taken in the spring, and the other that of samples taken in the fall. Fourteen hundred and ten samples were collected, and of these, seven hundred and sixty-one were analyzed. The samples analyzed were classified as follows:

Complete Fertilizers, containing Phosphoric Acid, Potash and Nitrogen,	470
Dissolved Bone, containing Phosphoric Acid and Nitrogen,	6
Rock and Potash, containing Phosphoric Acid and Potash,	102
Acidulated Rock, containing Phosphoric Acid,	98
Ground Bone, containing Phosphoric Acid and Nitrogen,	77
Miscellaneous, such as Potash Salts, and Nitrate of Soda,	8
Total samples analyzed in 1901,	761

The analyses shows that manufacturers are, for the most part, endeavoring to comply with the law, and are putting out goods up to the guarantee, and at fairly reasonable cost to the purchaser. In cases where goods fall below the guarantee in one element, they frequently overrun in the others thus, to some extent, equalizing the cost to the manufacturer, although not giving to the purchaser the precise fertilizing constituent which he had a right to expect. It is difficult in such cases to always determine whether the manufacturer intentionally lowered the particular ingredient, found to be deficient, or whether it was the result of defective manipulation in the mixing of the goods.

Until the end of the past year the Secretary, in whose hands is placed the enforcement of the law, had no direct power to compel its observance, owing to a clause in the act which provided that the

"informer be the purchaser and the goods be for his own use." A new act remedying this defect was passed by the Legislature of 1901, which goes into effect Jan. 1, 1902. This act also increases the license fee on fertilizers sold amounting to 100 tons or less, to fifteen dollars instead of ten. This increased sum will now about cover the expenses of collection and analysis.

Each year there is compiled and published for the benefit of manufacturers, as well as dealers and farmers, a schedule of values for the various ingredients which are used in the manufacture of commercial fertilizers, rating these constituents according to the ruling prices, which prevail at the time, in the wholesale trade in New York and Baltimore. The schedule of values for fertilizer ingredients for 1901 is as follows:

	Cents per pound.
Nitrogen:	
In ammonia salts,	16½
In nitrates,	14
In meat, dried blood and mixed fertilizers,	16
In cotton seed meal and castor-pomace,	16
In fine ground bone and tankage,	11
In coarse bone and tankage,	9
Phosphoric acid:	
Soluble in water, in bone fertilizers,	5
Soluble in water, in rock fertilizers,	3
Soluble in ammonium citrate, in bone fertilizers,	4½
Soluble in ammonium citrate in rock fertilizers,	2½
Insoluble in ammonium citrate, in bone fertilizers,	2
Insoluble in ammonium citrate, in rock,	1½
In fine bone, tankage and fish,	3½
In coarse bone and tankage,	2½
In cotton seed meal, castor-pomace and wood ashes,	4
Potash:	
In high-grade sulfate or in forms free from muriate,	5
As muriate,	4¼

Potash in excess of that equivalent to the chlorin present, will be valued as sulfate, and the remainder as muriate.

Nitrogen in mixed fertilizers will be valued as derived from the best sources of organic nitrogen, unless clear evidence to the contrary is obtained.

Phosphoric acid in mixed fertilizers is valued at bone phosphoric acid prices, unless clearly found to be derived from rock phosphate.

Bone is sifted into two grades of fineness: Fine, less than 1-50 inch in diameter; coarse, over 1-50 inch in diameter.

The result obtained by the use of this schedule does not cover the items of mixing, bagging, freight and agents' commission. To cover these, allowances are made as follows:

For freight, an allowance of $2.00 per ton on all fertilizers.

For bagging, an allowance of $1.00 per ton on all fertilizers, except when sold in original packages.

For mixing, an allowance of $1.00 per ton on complete fertilizers and rock-and-potash goods.

For agents' commission, an allowance of 20 per cent. is added to the cash values of the goods ready for shipment.

The mean quotations on freight from New York, Philadelphia and Baltimore to Harrisburg, in January, 1897, was $1.68 per ton, in lots of twelve tons or over; in May, 1899, quotations by the Pennsylvania Railroad were: From New York, $2.40; from Philadelphia, $1.70; and from Baltimore, $1.55; mean rate from the three points, $1.88.

The use of concentrated manures has been increasing in this State until, during the year, one thousand and one distinct brands were upon the market, and there was expended for them, according to the census in 1899, the enormous sum of $4,686,080. The benefit of their application is no longer questioned by progressive and intelligent farmers, and yet large as is the number of those who use them, many others who fully appreciate their value, hesitate to incur the additional expense of their purchase, for fear lest an unfavorable season or some insect pest, cause a failure of the crop and the money thus invested be temporarily lost.

The farm lands of the State have been gradually yielding up their valuable plant food to the crops which they have produced, until now in many districts, one or more of the necessary ingredients have become exhausted and the land refuses any longer to yield full crops without the restoration to it of some fertilizing ingredient which supplies this need. The problem of restoring lost fertility to the soil is, therefore, forcing itself upon the farmers of the State in a way and to a degree that demands immediate attention.

The great obstacle in the way of securing abundance of fertilizers is, of course, the cost; and yet this can in most cases be greatly reduced, if the farmer will study his soil and test its requirements. After doing this he may discover that a single and comparatively cheap ingredient is all that is necessary, and he can consequently save the money that he otherwise would have spent for several other costly ingredients which his soil did not need.

The securing of the costly fertilizer, nitrogen, through the use of leguminous crops, is now practiced by all advanced agriculturists, and the time doubtless will come, when the sale to the general farmer, of fertilizers containing this ingredient, will largely cease altogether. Many are also discovering that "cultivation is manure." Thorough cultivation has done marvelous things for poor soils and will continue to pay those who practice it a large percentage on the labor expended. It does this not only in effecting the more rapid decomposition of the rock elements, freeing them for the use of the

plants, but also in conserving the moisture in the soil for the use of crops instead of allowing it to evaporate and be lost.

The great question for the agricultural people in Pennsylvania to solve, is that of discovering how to secure abundance of good fertilizers cheap. The first duty is to carefully husband and utilize that which every farm yard contains; grow leguminous plants, cultivate the soil and then test the land with phosphoric acid, potash and nitrogen, applied separately, and note their effects upon the subsequent crops.

SPECIAL INVESTIGATIONS.

The law creating the Department of Agriculture provides for "Special Investigations" to be conducted under the direction of the Secretary. The remarkable progress which agriculture has made in the past few years has been largely due to the work of investigation conducted by State Experiment Stations, and the Department of Agriculture in the several States and at Washington.

Trained scientists in these institutions have been directing their attention and skill to the solution of problems in agriculture with the result of gradually elevating the calling into one of the learned professions. Science has indeed taken the hand of practice and is leading agriculture from the realm of empyricism into that of well established principles whose laws are as well defined and as certain in their action, as any others which control in the natural world. In many cases, scientific investigation upon a single subject must be continued for several years before any authoritive declaration can be made. Results must be tested and confirmed year after year before it is safe to announce them as well established facts. This Department has been engaged in this character of work for several years. Last year there were twelve distinct subjects undergoing examination, and this year seven:

Investigation into the habits of the Hessian Fly, under the various conditions of climate, soil and location in this State.

Investigation into the habits, life and adaptability of the Honey Bee to Pennsylvania conditions.

Investigation into the best methods of feeding steers for market.

Investigation into the best practice in the shoeing of horses.

Investigation into the character of the condensed milk industry.

Investigation into the character of the fats used in the adulteration of chocolate and cocoa.

Investigation into the character of canned goods found upon the markets of the State.

Accurate information upon these subjects is of the highest importance to the people of the State, and the Department is endeavoring to supply this information as rapidly as its resources will warrant.

If the investigation into the causes of the ravages of the Hessian Fly will enable our farmers to sow their grain at a date when this insect is not active, or to select a variety of grain that can resist their attack, many millions of dollars will annually be saved to the farmers of the State. During the year thousands of samples of growing wheat have been collected from all parts of the State and examined; the elevation of all the points of selection ascertained, and the conditions as to variety, date of sowing and character of soil all recorded. The farmers of the State have been very helpful in securing samples and transmitting them promptly to the expert who conducts the examination. As soon as possible the Department should be so enlarged as to be able to employ, as a part of its regular force, trained investigators who will devote their entire time to scientific work along agricultural lines. It is through such work that the agriculture of the future must be advanced.

PUBLICATIONS.

The Department has prepared and published during the year its sixth annual report in two volumes. Volume one contains 1009 pages, and volume two 318 pages. The law provides for the printing of 31,600 copies of this report, to be distributed, to the Senate, 9,000 copies; to the House of Representatives, 20,000 copies; to the Department of Agriculture, 2,000 copies; to the State Librarian, 500 copies; and to the State Agricultural Experiment Station, 100 copies.

The number apportioned to the Department of Agriculture is entirely inadequate; the editions of some years being entirely exhausted. At least 5,000 copies should be given to the Secretary for distribution in order to meet the demand.

Since the organization of the Department in 1895, there have been published 87 Bulletins of information to farmers. Seventeen of these

have been published during the past year. The Secretary is limited in the publication to 5,000 copies of any one bulletin. As a consequence some editions are exhausted, and no provision is made under the law for the issue of an additional number. The Secretary should have authority to print at least 20,000 copies in his discretion. The demand for Department publications is very great. As evidence of their value and of public appreciation, there has not been a day during the past year in which the mail has not brought requests for publications. They are called for by farmers and agricultural experts all over the United States and Canada, and numerous requests come from abroad, England, Germany, France, Australia and other foreign countries. In many cases these letters are accompanied with the request that the names of the writers be added to our list that they may get future publications.

These bulletins have been found very convenient in replying to inquiries for information upon special topics in agriculture. A bulletin treating of the subject is mailed to the inquirer, and in this way a much more satisfactory answer is given than would be possible in a written reply.

The following list shows the variety and importance of the subjects treated in the bulletins published during the past year.

Bulletin No. 71. The Consolidation of Country Schools and the Transporting of the Scholars by use of Vans; by H. H. Longsdorf, A. M., M. D. 89 pages.

Bulletin No. 72. Tabulated Analyses of Commercial Fertilizers. 171 pages.

Bulletin No. 73. Synopsis of the Tax Laws of Pennsylvania; by Gen. Thomas McCamant. 131 pages.

Bulletin No. 74. The Repression of Tuberculosis in Cattle by Sanitation; by Dr. Leonard Pearson, State Veterinarian. 23 pages.

Bulletin No. 75. Tuberculosis of Cattle and the Pennsylvania Plan for its Repression; by Dr. Leonard Pearson, State Veterinarian, and M. P. Ravenel, M. D. 262 pages.

Bulletin No. 76. A Co-operative Investigation into the Agricultural Seed Supply of Pennsylvania; by Prof. George C. Butz. 50 pages.

Bulletin No. 77. Bee Culture; by Dr. C. C. Miller. 103 pages.

Bulletin No. 78. List of County and Local Agricultural Societies; by Hon. A. L. Martin, Deputy Secretary of Agriculture. 10 pages.

Bulletin No. 79. Rabies; by Mazyck P. Ravenel, M. D. 28 pages.

Bulletin No. 80. Decisions of the Department of Agriculture on the Pure Food Act of 1895. 19 pages.

Bulletin No. 81. Concentrated Commercial Feeding Stuffs in Pennsylvania; by Wm. Frear, Ph. D. 135 pages.

Bulletin No. 82. Containing the Law Creating a Department of Agriculture in Pennsylvania, &c. 89 pages.

Bulletin No. 83. Tabulated Analyses of Commercial Fertilizers. 132 pages.

Bulletin No. 84. Methods of Steer-Feeding; by G. C. Watson and A. K. Risser. 16 pages.

Bulletin No. 85. Farmers' Institutes in Pennsylvania; Season of 1901-1902. 101 pages.

Bulletin No. 86. List of Licenses Granted by the Dairy and Food Commissioner. 421 pages.

Bulletin No. 87. Giving Average Composition of Feeding Stuffs. 42 pages.

The Bulletins published during the year would, if bound together, make a volume of 1,822 pages, representing a vast amount of work, most of it being by experts of established reputation.

LIBRARY AND MUSEUM.

Attention was called in last year's report to the importance of a well selected library for the use of the Department, and a small appropriation was asked for to be applied to this purpose. The Appropriation Committee did not allow the item, and the measure was dropped.

A few necessary books of reference were, however, purchased, which, together with the exchanges with agricultural departments in other States, has added quite materially to the library equipment. In estimating the space needed by the department in the new capitol building, a large room was requested for use as a library and museum. It is hoped, therefore, that when the Department is finally located in its new quarters ample provision will be provided for cases for books.

The necessity for a well equipped museum representing the agricultural capabilities of our State, is brought to our attention by the great National exhibitions being held each year, at which the resources of the several States are exhibited to the world. Pennsylvania is not behind the foremost of her sister States in agricultural production, and yet no exhibit worthy of her position and resources as a producing State is at hand for use upon such occasions. It is manifestly impracticable to prepare a proper exhibit in a single year or without an

appropriation of considerable amount. If, however, a moderate sum of money could be appropriated each year in the furtherance of a museum, very soon the State would have an exhibit of which it would not need to be ashamed. The appropriation asked for last year for this purpose was not given, and as a consequence, nothing could be done to carry forward this important work.

A modern museum in agriculture should not be a place for the mere piling up of material in order to fill space. It should be educational in its purpose rather than spectacular. To multiply bushels of grain or tons of vegetables, or the arranging of sheaves in fantastic form, has no educational value. Any well conducted city market will show all this any day of the year. A great State Department of Agriculture cannot afford to appear before an intelligent and discriminating public with the common-place, every-day productions familiar to every country child, but must make use of the advanced scientific knowledge of agriculture and exhibit the results of the application of this knowledge in the producing of crops. An exhibition of wheat, for instance, should show the plant in its stages of growth. The grain, the flower, the roots, the bran, the dust. There should be shown the starch, the gluten, the oil, the chemical constitution as affected by fertilizers, soil, moisture, sunshine; should show the soil and its constitution, the insects that affect the plant, the fungus diseases that attack it, the yield, the fertilizers adapted to its growth, together with an account of the rainfall which it received, the temperature during the period of growth, and all of the facts that had any influence in the production of the crop. Such an exhibition becomes a study and is worth the time and attention of any man who is interested in knowing the best way to cultivate or manufacture this cereal. An exhibit at any great fair, to be at all in keeping with the dignity of the State, should be arranged in Divisions, each in charge of a scientific expert, to prepare, and afterwards to oversee, while on exhibition. A Division of Cereals, one of Forage Crops, one of Live Stock, one on Dairy Products, others on Soils, Fruits and Fruit Husbandry, Vegetables, Flowers and Foliage Plants, Insects, Fertilizers, Poultry, Tobacco, Bacteria, Statistics. Such an exhibit, properly prepared, arranged and explained, would be worth more to the farming public than all of the train loads of products usually heaped up in agricultural buildings at these great fairs. By having such an exhibit, placed in portable cases, it could be preserved from year to year and serve to interest and instruct agricultural people for a generation to come, and always be available for shipment to any part of the country where its presence is desired.

The Department of Agriculture ought to begin the preparation of such a Museum, and a proper appropriation for this work ought to be made by the next Legislature.

GOOD ROADS.

Good roads for the country districts in Pennsylvania have become a social and business necessity, and their construction cannot be much longer delayed.

Social and business conditions have so changed, that agriculture which forty years ago was supreme among the occupations in the number of those who pursued it as a calling, is now but one of many industries and professions which invite attention. The new industries which have developed so wonderfully in recent years are mostly located in the towns and cities, as a consequence, country people, attracted by what they suppose to be greater business opportunities and social advantages, are flocking to these centres of population, and the country, as has been indicated in another part of this report, is rapidly losing its strength and influence in the government of the State.

However widely individuals may differ as to the influence which bad roads have had upon this movement of population, there is no disputing the fact, that where rapid, cheap and easy transit exists in the country, the flow is to that district from the near by cities and towns. Abington township, Montgomery county, Pa., has highly improved roads. The population of this township in 1890 was 2,703. In 1900 the population has increased to 3,803, and there had also been formed a borough of 512 people, making a total gain of 1,612 in ten years.

Cheltenham township, which adjoins Abington, had a population in 1890 of 4,746. In 1900 this had increased to 6,154. Lower Merion township, in Delaware county, where Mr. A. J. Cassatt constructed goods roads a number of years ago, increased in population 3,756. Haverford township, which adjoins Lower Merion, shows a gain of 681. Moreland township, adjoining Abington, shows a gain of 573. All of these townships have improved roads, whilst Upper Dublin township, also adjoining Abington township, with unimproved roads, lost population in the last decade. This locality has been chosen for the illustration, because here the best roads in the State have been built, and the effects are seen in the population which flows into these localities, whilst other places, near by but with unimproved roads, are losing year by year. Not only has the rural population largely increased in these good road districts, but the value of land has been enhanced and the character of the citizenship has greatly improved. It can scarcely be regarded as accidental, that these localities, in which the best roads exist, are increasing in population and wealth.

whilst others, near by, and unimproved in this respect, are either standing still, or retrograding. Quick and easy transportation has become a necessity in the country as well as in the cities, and population will leave a community where this cannot be had.

Free Rural Mail Delivery also joins in the demand for good roads. This great public convenience cannot exist, where the roads are unsuitable for travel during any considerable portion of the year. The farmers are coming to realize this, and are, after a fashion, endeavoring to improve their roads, but the lack of skilled and constant supervision makes the effort costly, and the results altogether unsatisfactory.

The Hon. A. W. Machen, General Superintendent of the Rural Free Delivery System, U. S. Postal Department, in a paper presented at the meeting of the International Good Roads Congress at Buffalo, declared that "the only obstacle now encountered in the extension of rural free delivery is the unimproved condition of our country roads. In many sections of this country the roads are what are called dirt or mud roads. They are narrow and tortuous, and the only work done on them is practically confined to going over them with a road machine or scraper once a year. The principal effect of this work is to pile up in the middle of the road all the muck and rubbish which has accumulated on the sides during the rest of the year, so that in wet weather, unless the soil is very sandy, the whole surface becomes rutted and is soon converted into a series of mud-holes. This is particularly the case in most of the farming sections of the middle west, and to a large extent in the south; also as far east as western New York and Pennsylvania. * * * Goods roads are indispensible to a really efficient service. * * * A well-built and well-kept road will permit of such a service; over bad roads it cannot be maintained."

This statement, coming from the source it does, is notice to the public that free rural mail delivery will depend for its extension upon the condition of the public roads.

But the most urgent demand for good roads comes from the public schools in the country districts. If, as is shown in another part of this report, the consolidation of the schools is the only solution of the problem of securing the proper and economical education of country children, it certainly also is true, that the consolidation cannot be completely effected until good roads make the transportation of the children to and from school possible. Good roads and better rural schools are dependent upon each other. The latter cannot be had without the assistance of the former, and country people are now coming to realize this as never before.

The question of farm labor in the future must be largely solved through the improvement of the public roads. The great obstacle in

retaining labor in the country is found in the fact that from December until April there is nothing for the day laborer to do, consequently he sells his home, moves to the town, rents a house near a factory, and so is lost to the community in which he was raised. A good road to the town would to a great extent have remedied this. It would have enabled the laborer to live anywhere from four to five miles in the country, retain his home and surroundings, and on a bicycle, run to town in from twenty to thirty minutes, in time for work.

Quick, easy and cheap transportation will also enable the country resident to secure help from the towns in times of special necessity, such as occur at the time of the planting, harvesting and care of crops. The towns and cities thus become reservoirs of labor, where assistance can be had by the country in time of need.

The value of improved roads in affording increased facility for the marketing of crops, attendance upon church, visits to the store, or shop, are too well known and appreciated to make it necessary to further discuss.

Good roads for the country have become a social and business necessity for country people, and in no State is this necessity greater, or reform in methods of road construction more needed, than in our own State of Pennsylvania. We have, in this State, about one hundred thousand miles of country roads, constructed and maintained under a system of supervision in which the selection of supervisors, not of the fittest, but of the most unfit, is usually made. By it men are selected who are willing to stand out on the public roads for a dollar and a half a day and watch two or three other men do nothing, often worse than nothing, do positive damage to an otherwise passable road. As long as this system exists, just so long will our roads be unsatisfactory. Incompetent supervision, in any branch of business, is destructive of that business. Road supervision is no exception to this rule, and this accounts for the deplorable condition of our roads, notwithstanding the expenditure of over four millions of dollars in their maintenance each year, or about forty dollars per mile annually on every mile of road. The wise expenditure of this sum, would, of itself, give us improved roads in comparatively few years, but, until a system is adopted which insures proper supervision, we can only expect, that which we have already experienced in all of the past years, wasted money and bad roads.

We have been endeavoring, for several years, to get aid from the State for road improvement, but so far have failed to secure it. State aid will never be given, and ought not to be given, until the State is assured that the money which it contributes is more wisely expended, than that which the townships now raise. A law is now on the statute books which aims to provide competent supervisors, but is

inoperative until one million of dollars has been set aside by the Legislature for road purposes. This law provides in general:

First. For a Board of three supervisors in each township, elected, one each year for three years.

Second. For road masters appointed by the Board of Supervisors, to have immediate charge of the roads and oversee the work.

Third. For a treasurer of the Board, who keeps the books and accounts and attends to all of the clerical work of the Board.

The distinctive feature of this law is, in providing a Board that shall be continuous; never going out of existence; whose members will not have to stand over the workmen and see the work done, but simply give direction to the road masters who shall attend to this duty. This makes it possible for the most busy man in a community to act on the Board of Road Supervision, and so the best talent can be selected to give direction in road construction and improvement, instead of the most incompetent.

The law is not a road law, strictly speaking, but a supervisors' law. It constitutes a Board which is continuous; never closes accounts; is always in existence; always on duty, and the majority of whom will have had at least one year's previous experience.

At present, in about all of the road districts, the entire Board of Supervisors go out of office at the end of each year, and a totally new and inexperienced set come in. These new men must be educated in road control, but as soon as they get some information, a new set comes in, as ignorant as their predecessors, and the reign of incompetence is continued.

A permanent continuous Board can be educated, and although one man goes out each year, the information remains in the Board, and in the course of a few years, the Board is fairly well educated; instead of being a system of retrogression, we have one of progression and accumulation. Teach first, how to construct a good road; and second, how to maintain it. As soon as such boards can be put into control, then we are ready for State aid, and not before.

Aid from the State in Pennsylvania means assistance from corporations, money at interest, loans and taxable property other than real estate. In Pennsylvania, State aid to the townships, means receiving money from the State, by country people, which they did not contribute, but which comes from other sources.

These other interests, which are thus taxed for road purposes, are just as much benefited by the improvement of the roads, through the country districts, as are the country people themselves, and it is not a bonus or gift, to the country people, to provide State aid from this fund, but it is simply an investment, on the part of the State, for the benefit of all of the interests of the Commonwealth.

CATTLE FOOD CONTROL.

Early in the session of the Legislature of 1901, the Department prepared a bill for providing for the inspection of cattle foods. The bill required that all packages of concentrated feeding stuffs, manufactured or sold in this State, shall have affixed thereto, in a conspicuous place on the outside thereof, a legible and plainly printed statement clearly and truly certifying the number of net pounds of feeding stuff contained therein; the name, brand or trade mark under which the article is sold; the name and address of the manufacturer or importer, and a statement of the percentage it contains of crude fat and of crude protein. This bill, after being amended in several particulars, was passed and is now on the statute books of the State. The act did not go into effect until October of 1901. Manufacturers and dealers were notified of the passage of such a law and a copy was sent for their information.

Preparations have been completed for taking samples for analysis after the first of January, 1902. The law requires the labeling of all packages containing linseed meal, cotton seed meal, gluten meal, maize feed, sugar feed, dried brewers' grains, malt sprouts, hominy foods, cerealine feed, rice meal, ground beef or fish scraps and all other materials of a similar nature. No foreign mineral substance, nor substance injurious to the health of animals, shall be mixed with any feeding stuff sold, or offered or exposed for sale in this State. A bulletin, giving tables showing the composition of feeding stuffs, has been published, accompanied with an explanation of the method of calculation to be pursued. This will aid manufacturers and dealers, as well as consumers, in compounding or mixing grains or other concentrated feeding stuffs so as to secure a mixture containing the relative proportions of protein and fat which they wish in a ration, and also enable them to form a proper estimate of the money value of the food. Other States have found laws of this character very beneficial and we also may expect similar advantages from the law lately enacted for this State.

AGRICULTURAL EDUCATION.

Rural Schools.

The past year marks an era in the history of the education of country children in Pennsylvania. An examination of the conditions which have existed in the country schools by which the teacher was required to hear an average of twenty-seven classes each day, with only the present limited course of study, made it clear to the Legislature that something should be done to relieve the country school teacher of this burden, and at the same time provide for the giving of a course of study to children in the country districts equal to that found in the best town and city schools. This was accomplished by making an appropriation of $50,000 for the carrying, of the Township High School Law of June 28th, 1895, into effect, and by the passage of an act providing for consolidating the township schools into a single central graded school and for the transportation of scholars to and from this central school. The operation of these two laws will make it no longer necessary for parents to send their children to the town or city schools to be educated, but their academic training, preparatory to entrance into college, can be had in every community. Necessary additional studies can now be introduced, and the children can have more of the teachers' time and attention than was possible in the isolated school. The deep interest which exists among country people in regard to the new law providing for the consolidation of the schools, is seen in the farmers' institutes which were held in the past autumn. Expressions of gratification are heard in every institute meeting, and numerous inquiries come to the Department asking for documents explaining precisely the method of carrying the law into effect.

No State has now more advanced legislation in this direction than ours, and no law passed by any legislature since the enactment of the consolidation act of 1854, is more valuable to country people. This one act, in the interest of agriculture, is worth, in my judgment, all that the Legislature of 1901 cost to the people of the State.

AGRICULTURAL ORGANIZATIONS.

The State is fortunate in having a number of influential and efficient societies founded for the promotion of the interests of agriculture within her borders, and which are now actively engaged in fulfilling the purposes of their creation.

These organizations are purely voluntary associations, composed of public spirited gentlemen who were interested along one or more lines of agriculture, and who have found it profitable to meet and exchange views, hold exhibitions, encourage new methods of practice, and aid in promoting a more general and intelligent interest, on the part of country people, in agricultural development and education.

County Societies.

Among the earliest of these organizations, were the county agricultural societies, established originally for the purpose of holding exhibitions of farm crops, animals and machinery. Year after year, these societies met, and by means of premiums offered for superior articles, stimulated agricultural people to exercise greater care in their farming and make an effort to excel in the production of some article or animal which would surpass those previously produced.

Eighty-three of these county or local associations are now in existence in the State, most of them being incorporated and officered with a president, secretary, treasurer and board of directors. The reports of these associations for the year 1900, made to the Deputy Secretary of this Department, show "that the attendance at 49 of these societies in 1900 was 1,143,071, or an average of 23,327 for each society so reporting. There were held during 1900, fifty-six agricultural exhibitions in the State. The total premiums paid by forty-nine of these societies in that year are recorded at $119,830.60, or an average for each of the 49 societies so reported, of $2,445.52. Thirty-nine societies offer a total in premiums for 1901, of $133,350.00, or an average of $3,419.23 for each of said societies so reported. This represents an increase in premiums offered this year, over and above those paid in 1900, of 39 per cent. A total of forty-seven of the societies herein recorded have a one-half mile race track, and seven a one-third mile track."

It is evident, that, as a means of education, these associations have

exceptional opportunities. The thousands that attend them are there to see and to hear anything that may be of interest or use. Careful study, therefore, should be given to the question of the character of the exhibits and entertainments. The effort should be to have all of the departments of the fair interesting and instructive. To secure these ends, the first question that should be taken up is, What do the agricultural people most need to know? After having discovered this, then plan to meet their wants. It will soon be discovered that they are not much interested in things that are inferior or of only ordinary character. They desire to learn, and in order to make this possible, the best should be presented and every effort be put forth to secure specimens, as near perfection as possible in each class.

State Agricultural Society.

The interest excited by the local societies, resulted in the formation of a State organization in 1851, known as the State Agricultural Society. The list of members of this society, embraces the names of a large number of the most influential and capable citizens, that the last half century has produced in Pennsylvania. Ever since its organization, this society has held exhibitions each year, most of which have been remarkable for attendance and interest. Unfortunately, the society some years ago, became involved, through no fault of its own, in a debt which has seriously crippled it ever since. It is now, however, about clear of this incumbrance, and is again ready to occupy its old position of prominence and usefulness in the agriculture of the State. In New York State the Legislature makes a large appropriation, annually, to the State Fair Association, to aid in the payment of the premiums offered, with the result that their yearly fairs are now regarded as among the best in the United States, and large numbers of farmers, from other States visit them for the purpose of securing the valuable information which the exhibit provides. Pennsylvania ought to do a like service for its State Society, and aid its managers in their efforts to show to our own citizens and those of other States, what Pennsylvania agriculture actually is, by exhibiting her best products in a general collection, where, at slight expense, they can be viewed and compared, by all who are interested in this great industry.

The State Board.

The Agricultural Society was organized, chiefly, for the purpose of holding exhibitions or fairs. After about twenty-five years of expe-

rience in this method of educating the public in agriculture, some of our citizens felt that the times required a more scientific form of instruction, and in 1876, the State Board of Agriculture was organized by act of the Legislature, composed of one member elected by each county agricultural society which was entitled to $100 from the county treasury, from having contributed a like sum for exhibition purposes. This new organization, or Board as it was called, devoted itself to meeting and hearing papers read upon agricultural subjects, and in discussing these papers, and afterwards publishing the proceedings in an annual report.

The Board has been of great service to the agriculture of the State, and the reports of its sessions are among the most valuable of any found in any of the States of the Union. It still convenes in annual meeting and has added to its original purpose the active oversight, under the direction of the Department of Agriculture, of the work of the Farmers' Institutes in the several counties of the State. Its services, in this respect, are very valuable, and the Board is entitled to great credit for its intelligent and hearty interest in this important branch of our educational system.

State Horticultural Association.

This organization is one of the oldest of the unincorporated societies of the State. It was organized over forty years ago, and has kept up its meetings ever since. The society was organized, chiefly for the self-improvement of its members; but like all useful organizations, its benefits have extended to the entire State. The fruit industry has been greatly aided by this association, and it ought to be assisted and encouraged in its efforts to improve and increase the fruit production of the districts adapted to this industry.

The Dairy Union.

The Dairy Union is another of the unincorporated societies, organized in the interest of the dairy industry of the State. It is of only recent origin, so that the effect of its work has not yet had time to show as in the case of the older societies. Its purposes are to encourage dairy farming in this State, to improve the industry and protect it against fraudulent imitation products, which threaten its destruction.

The State Live Stock Breeders' Association.

This is also a new organization in this State, unincorporated. Pennsylvania, until quite recently, has never had a society of breeders

to look after the interests of this branch of farming, but we have had to depend for improved stock, upon the individual enterprise of our citizens, unassisted by others similarly engaged, or by the State itself, which is directly interested. The State can greatly assist organizations of this character by publishing the results of their meetings for general information, and by meeting the comparatively small expenses involved in securing the services of capable lecturers to give instruction.

The State Poultry Association.

This is the last of the strictly State societies in the interest of agriculture which are special in their character. What is true of the Dairy Union and the Stock Breeders' Association, is also true of this organization—it ought to be aided by the State to the extent of securing lecturers and publishing reports.

It is gratifying to know that all of these organizations are in thorough sympathy with this Department and have co-operated with it in its wider work of educating and assisting in the entire field of agriculture. The Department, on the other hand, has done what it could to aid all of these societies, and will continue to assist them in the work of advancing the great agricultural industry of the State.

FARM AND LIVE STOCK STATISTICS.

The census returns for 1900 show that farm property in Pennsylvania has diminished to the amount of $2,615,100 below the valuation of 1890. This shrinkage has been in the value of land, and the improvements and buildings. The value of these items in 1890 was $922,240,-233, and in 1900, $899,816,930, being a decrease of $22,423,303. On the other hand, implements and machinery show a gain of $11,870,533; their value being given at $39,046,855 in 1890, and $50,917,390 in 1900.

Live stock also shows a gain. Their value in 1890 was $101,652,758 and in 1900 $109,590,426, a difference of $7,937,668. These two items of gain, deducted from the loss on farm land, buildings and improvements, leaves a net shrinkage of $2,615,100.

The number of farms has increased from 211,557, in 1890, to 224,248, in 1900. The total number of acres in farms has also increased from 18,364,370, in 1890, to 19,314,972, in 1900. This increase, however, was in the unimproved portion of farms, whilst the improved portions show a decrease of acreage.

The improved lands in 1890 are given at 13,210,597 acres and the unimproved at 5,153,773 acres. In 1900 the improved lands are given at 12,609,240 and the unimproved at 6,705,732 acres.

The 224,248 farms are operated as follows:

By owners,	153,031
Part owners,	7,074
Owners and tenants together,	2,174
Managers,	3,703
Cash tenants,	23,737
Share tenants,	34,529
Total,	224,248

The number of dairy cows has increased from 927,254 head in 1890 to 943,73 head in 1900.

Other kinds of neat cattle have increased from 761,800 head in 1890 to 953,074 head in 1900.

Horses have decreased from 618,660 in 1890 to 590,981 in 1900.

Mules and asses have increased from 29,563 in 1890 to 38,635 head in 1900.

Sheep have diminished from 981,298 in 1890 to 959,483 in 1900.

Swine have decreased in number from 1,278,029 in 1890, to 1,107,981 in 1900.

The following table shows the number and value of live stock in Pennsylvania as found by the census of 1900:

NUMBER OF DOMESTIC ANIMALS, FOWLS AND BEES ON FARMS JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

Live Stock.	Age, in Years.	On Farms. Number.	On Farms. Value.	On Farms. Average value.	Not on farms—Number.
Calves,	Under 1,	421,323	$3,032,067	$7.19	9,181
Steers,	1 and under 2,	108,681	1,739,459	16	1,753
Steers,	2 and under 3,	64,252	1,903,405	29.62	1,358
Steers,	3 and over,	16,382	712,704	43.50	706
Bulls,	1 and over,	69,006	1,607,337	22.79	855
Heifers,	1 and under 2,	224,623	3,705,397	16.45	5,342
Cows kept for milk,	2 and over,	943,773	29,141,561	30.87	77,954
Cows and heifers not kept for milk,	2 and over,	48,807	1,221,261	25.02	1,366
Colts,	Under 1,	28,547	806,696	31.76	869
Horses,	1 and under 2,	36,584	1,916,501	52.38	1,328
Horses,	2 and over,	525,850	38,225,630	72.65	215,997
Mule colts,	Under 1,	1,144	45,876	40.09	50
Mules,	1 and under 2,	3,604	210,286	58.34	175
Mules,	2 and over,	33,311	2,651,528	79.59	21,942
Asses and burros,	All ages,	576	22,559	39.16	601
Lambs,	Under 1,	571,583	1,327,924	2.32	2,347
Sheep (ewes),	1 and over,	769,463	2,651,067	3.44	3,216
Sheep (rams and wethers),	1 and over,	190,020	663,615	3.48	497
Swine,	All ages,	1,107,981	5,830,295	5.26	150,329
Goats,	All ages,	2,197	8,951	4.07	6,547
Fowls:*					
Chickens,†		10,553,106	11,634,729		
Turkeys,		259,824			
Geese,		60,780			
Ducks,		171,271			
Bees (swarms of),		161,670	531,578	3.29	
Value of all live stock			$109,590,426		

*The number reported is of fowls over 3 months old. The value is of all, old and young.
†Including guinea fowls.

POPULATION IN THE RURAL DISTRICTS.

To those who believe that in the population of the rural districts the State must look for the vitalizing forces that are to overcome the physical, mental and moral degeneration which is taking place in city life, the flow of population from the country to the city has become alarming. In the last decade the cities and boroughs in sixty-

five counties show a total gain of 1,020,830 in population, and in two counties a total loss of 61, leaving a net gain in population in cities and boroughs of 1,020,769.

The country districts, on the other hand, showed a gain in twenty-four counties amounting only to 113,552. Forty-three counties show a loss of 90,220, leaving the net gain of population for all of the rural districts of the State, of only 23,332. The gain, in the country districts, occurred, for the most part, in the lumbering and mining counties. The gain in the ten lumbering and mining counties, consisting of Cambria, Clearfield, Elk, Fayette, Forest, Jefferson, Lehigh, Luzerne, Somerset and Westmoreland, amounted to 87,665. The aggregate loss to the country districts in the fifty-seven other counties was, therefore, 64,333, showing beyond question that the agricultural population is gradually growing less in the country districts of Pennsylvania.

Suggestions are offered, in other parts of this report, as to the means for arresting this flow. Better schools, better roads, the reduction of taxation upon real estate by a more equitable imposition of tax upon occupations, professions and trades, the dissemination of scientific information among agricultural people by means of bulletins and farmers' institutes, the introduction of the study of natural things into the rural schools, and the extension of free rural mail delivery, telephone and trolley roads throughout the country.

The country must be made easily and quickly accessible, from the cities and towns, and the same educational advantages now enjoyed by the towns, must be introduced into the country.

THE LEGISLATION OF 1901.

The farmers of Pennsylvania have good reason to commend the last Legislature for its consideration of their needs, as shown in the large amount of valuable legislation which was enacted in the interest of agriculture. They passed no less than thirty-three distinct bills directly benefiting the country districts.

Among those of the greatest importance, is the new Commercial Fertilizer law, which increases the license fee from ten to fifteen dollars for sales of one hundred tons and less, and extends the powers of the Secretary of Agriculture by authorizing him to prosecute offenders directly without having to do so through some purchaser. Under the practice and workings of the old law, which provided that the "informer be the purchaser and the goods be for his own use," no one could be punished for its violation.

There is also the "wide tire" law, which grants an annual rebate of one-fourth of the road tax, not exceeding the value of five days' labor, to all who will use a tire of not less than four inches wide in hauling loads of two thousands pounds and over.

The hauling of loads of ten thousand pounds and over is prohibited, under penalty, unless the wagon has tires at least four inches wide. This is a most important advance in the interest of better roads, since it aims to reduce the wear upon the public highways, by increasing the bearing surface of the wheels, making them rollers, smoothing and compacting the roadway, instead of the knife-like disks which cut it into ruts.

Another important law, relating to the improvement of the public roads, was passed, amending the act of 1899, which provided for the gathering of stones from the highways once each month during the summer season. The amendment provides a penalty not exceeding ten dollars, to be collected, with costs of suit, from the supervisors, for failure to pick the stones off from the public roads once each month for the months of May, June, August and October.

A law was passed for the "Protection of Live Stock" against infection from animals dying of contagious or infectious diseases, such as anthrax, black quarter, hog cholera, swine plague, rabies or glanders. The carcass of such animals must be disposed of in such a way as to effectively destroy or sequester the poison, germ, parasite or infective agent of the disease, with which the animal was afflicted at the time of death. The forbidding of the former careless methods, which dragged the carcass to the woods, to become the prey of dogs or birds or to contaminate streams, is a wise precaution, and will protect the owners of live stock from ignorant or careless neighbors.

A law was enacted which provides for the "Inspection of Concentrated Commercial Cattle Feeds." Investigation showed that many of the cattle feeds put upon the markets of Pennsylvania are adulterated so as to be almost worthless. The purchasers of such feeds had no way of discovering their character without going to great trouble and expense, and thus many thousands of dollars were lost annually to the farmers in the purchase of worthless material. This law requires the tagging of all packages containing concentrated

Act No.

62. "An act to prevent the adulteration of, and deception in the sale of linseed or flaxseed oil."

63. "To amend the ninth section of an act, entitled 'An act for the taxation of dogs and the protection of sheep,' approved the twenty-fifth day of May, one thousand eight hundred and ninety-three."

71. "To encourage the use of wide tires upon wagons upon the public highways of this Commonwealth, and providing penalties for its violation."

77. "To provide for the centralization of township schools, and to provide high schools for townships."

78. "Regulating the sale of concentrated commercial feeding stuffs, defining concentrated feeding stuffs, prohibiting their adulteration, providing for the collection of samples, the expenses of the enforcement of the law, and fixing penalties for its violation."

86. "For the better protection of timber lands against fire, and providing for the expense of the same, and directing what shall be done with the fines collected and costs paid."

88. "To provide for the prevention of the spread of disease from the carcasses of animals that die of dangerous or virulent diseases, or are killed while afflicted with such disease; to provide for the safe disposal or destruction of such carcasses; to authorize the State Live Stock Sanitary Board to make regulations for the enforcement of this act; and to provide penalties for the violations of this act and of the regulations that may be made under it by the State Live Stock Sanitary Board."

89. "Relative to adulteration of natural fruit juice, and providing penalties for violations thereof."

95. "To amend section two of an act, entitled 'An act to prevent fraud and deception in the manufacture and sale of cheese, and defining what shall constitute the various grades of cheese, providing rules and regulations for marking and branding the same, providing for the enforcement of this act, prescribing penalties for its violation,' approved the twenty-third day of June, Anno Domini one thousand eight hundred and ninety-seven."

164. "To prohibit the sale of adulterated, unwholesome or impure milk in cities of the second class; providing for the licensing of persons engaged in dealing in milk, and providing penalties for violation thereof."

174. "Authorizing county commissioners of the several counties of

Act No.

this Commonwealth to construct any public road, leading to either end of a county bridge across any river in this Commonwealth."

183. "To amend the first and second sections of an act, entitled 'An act providing for the regulation of the manufacture and sale of distilled and fermented vinegars; prescribing their standard and to prevent the adulteration of the same; providing for the enforcement thereof, and punishment for the violation of the same,' approved the eighteenth day of June, Anno Domini one thousand eight hundred and ninety-seven, so as to provide that vinegar made wholly from grapes, apples or other fruits, shall not be required to contain an acidity of four per centum."

208. "To prohibit the manufacture and sale of oleomargarine, butterine, and other similar products, when colored in imitation of yellow butter; to provide for license fees to be paid by manufacturers, wholesale and retail dealers, and by proprietors of hotels, restaurants, dining-rooms and boarding houses; for the manufacture or sale of oleomargarine, butterine, or other similar products, not colored in imitation of yellow butter; and to regulate the manufacture and sale of oleomargarine, butterine, or other similar products, not colored in imitation of yellow butter, and to prevent and punish fraud and deception in such manufacture and sale as an imitation butter; and to prescribe penalties and punishment for violations of this act, and the means and the method of procedure for its enforcement, and regulate certain matters of evidence in such procedure."

257. "For the protection of trees, shrubs, vines and plants, known as nursery stock, against destructive insects; providing for the enforcement of this act, the expenses connected therewith, and fixing penalties for its violation."

280. "To regulate and define the boundary lines of public roads."

287. "To prevent the importation and sale, in the Commonwealth of Pennsylvania, of dressed carcasses of lamb and sheep with the hoofs on."

295. "To amend an act, entitled 'An act to provide for the centralization of township schools, and to provide high schools for townships,' approved April twenty-fifth, one thousand nine hundred and one."

307. "To amend an act, entitled 'An act to provide for the improvement of the main traveled public roads,' approved May second, one thousand eight hundred and ninety-nine; changing

Act. No.

the time said act should be in operation, and imposing a penalty in case of neglect or refusal of supervisors or road commissioners to carry out the provisions of said act."

308. "Making it wilful trespass to hunt, trap and take game birds or game animals upon cultivated lands, and providing for the punishment of such trespass."

327. "Defining boiled or process butter; designating the name by which it shall be known; providing for the licensing of manufacturers and dealers therein, and regulating the sale and labeling of of the same, so as to prevent fraud and deception in its sale; providing punishment for violations of this act, the methods of procedure for its enforcement, and certain matters of evidence in such procedure."

399. "Making an appropriation to the State College, to maintain experimental stations for the purpose of making experiments in the culture, curing and preparation of tobacco, and providing for the publication of the report thereof."

413. "To provide for the investigation of the diseases of domestic animals, and making an appropriation therefor."

439. "Making an appropriation for the protection of game, of song and insectivorous birds."

503. "A further supplement to an act , entitled 'An act to accept the grant of public lands by the United States for the endowment of agricultural colleges,' approved April first, one thousand eight hundred and sixty-three, and making appropriations for carrying the same into effect."

CONCLUSION.

An examination of the reports of the Division officers shows, not only the great amount of work performed during the past year, but also, its variety and importance, to the people of the State. The Department comes into direct contact with practical agriculture, in many different directions. Its work, consequently, is of necessity, wide extended and must be of a helpful nature, in order to be of service. This service is rendered through the use of bulletins of information, Farmers' Institutes, nursery, food and fertilizer inspections,

the protection of live stock against disease, the clearing of the markets of impure and fraudulent food products, and suggesting and securing of legislation in the interests of the agricultural people of the State.

The work involves the use of the best experts which the State possesses in the several directions mentioned, and its value to the public depends directly upon the reliable character of the information which the Department disseminates, as well as upon the nature of the information itself.

Most of the work, necessarily new from year to year, is out of the old beaten track of routine, and along paths, many of which, are comparatively untrodden. This advanced work requires the greatest care, in its performance, lest mistakes occur which may injuriously affect some of the great industries that are serving the country, with honest intentions to deal justly by the consuming public.

The cordial good feeling that exists towards the Department, and appreciation of its work, by the agricultural people of the State, have been expressed, in a very gratifying way, by the several great agricultural organizations of the State, in their resolutions of confidence and promises of support. The untruthful and malicious character of many of the criticisms which have been made, have been so thoroughly demonstrated, that their authors, who are well known, have come to be regarded as disreputable and their statements unworthy of credit. The work of the Department speaks for itself, and the correspondence shows that it has the approval and respect of the best citizens of this and other States.

I wish to acknowledge the intelligent and hearty support which I have received from the several Division officers, and the clerical force of the Department, and also to express my appreciation of the assistance which you have rendered in making the Department more useful to the citizens of the State, and for the kind consideration which you have extended to me in our official and personal relations.

Very respectfully,

JOHN HAMILTON,
Secretary of Agriculture.

REPORT OF THE DEPUTY SECRETARY AND DIRECTOR OF INSTITUTES.

Harrisburg, Pa., December 30, 1901.

Hon. John Hamilton, *Secretary of Agriculture:*

Dear Sir: In presenting this annual report, it affords me pleasure to record a successful and progressive year's work. The attendance at institutes has been fully maintained which, however, has often been limited by the capacity of halls and churches to accommodate the crowds. Unusual interest has been shown in the meetings, and a general increased desire on the part of the farmers of Pennsylvania for further instruction and broader knowledge of matters pertaining to farm life and work, has been manifested. Want of space would forbid the publishing in detail of a report of 320 days of institutes held during the season of 1900-1901. In order that a fair knowledge of the leading topics which were under discussion may be given, we herewith insert a programme as carried out in my native county of Lawrence.

PROGRAMME.

Opening Session.

Wednesday Afternoon, January 2, 1901, 1:30.

John Magee, ...Chairman.
Prayer, ...Rev. Stewart

Music.

The Soil—Its Care, Culture, Food,.........John Smith, London, Pa.
Stock—Care, Breeding and Feeding,.....M. M. Keener, Plain Grove.
Feeding for a Purpose, with Special Reference to Dairying,
Col. John A. Woodward, Centre Co. Pa.

EDUCATIONAL SESSION.

Wednesday Evening, January 2, 1901, 7:00.

Jas. Peebles, ...Chairman.

Music.

What Education Does the Farmer Need?
Prof. J. C. Ricketts, Slippery Rock, Pa.
The Farmer as a Student, ...F. T. Glenn, Plain Grove.
They Boy on the Farm—His Advantages and Possibilities,
Rev. Stewart, Plain Grove.
The Rights of the Child—Educational and Otherwise,
S. S. Brockway, Greenville, Pa.

FARMER'S SESSION.

Thursday Morning, January 3, 1901, 9:30.

Wm. Gealey, ...Chairman.

Music.

The Silo, ...Rob't McCoy, Slippery Rock, Pa.
Farm Help, ...Jas. Peebles, Harlansburg, Pa.
Preparation of Seed Bed, ...Dr. I. A. Thayer, New Castle, Pa.
Growing of Mixed Grasses, ...Hon. S. H. Miller, Mercer, Pa.

WOMAN'S SESSION.

Thursday Afternoon, January 3, 1901, 1:30.

Mrs. S. A. Stewart, ... Chairman

Music.

How to Lighten the Labor of the Farmer's Wife,
Mrs. Alex. Bingham, Leesburg, Pa.

In What Way Can the Social Life on the Farm be Improved?
Mrs. M. J. Elliott, Elliott's Mills, Pa.

How to Make the Country Home Convenient and Comfortable,
Mrs. Harvey Rodgers, Plain Grove.

With additional remarks on the same subject by Col. Woodward.

EVENING SESSION.

Thursday Evening, January 3, 1901, 7:00.

N. A. Offutt, ... Chairman.

Draining for Profit, ... A. J. Coulter, North Liberty, Pa.

Farm Machinery—Its Care, Use and Abuse,
Thos. McCoy, Plain Grove, Pa.

The Farmer's Home, ... I. A. Thayer.

Beautifying the Home Grounds, ... R. L. Watts, Cambria Co., Pa.

This programme will, in some measure, exhibit the great scope of information embraced by the institutes, also the different and varied lines of farm operations carried on by the farmers of Pennsylvania.

ranking, as she does, second amongst all the States of the Union in population, first in the manufacture of iron, first in the production of oil, first in the amount of coal mined, while in the value of her agricultural products, such as wheat, corn, oats, hay, potatoes, horses, cows, swine and sheep, our State stands well to the front. It only requires a citation of these figures to prove the importance of the institute as an educational factor in equipping the farmer with scientific knowledge and acquainting him with the most improved methods employed in all lines of farm work. And the time is fast approaching when the farmer will fully realize the importance of utilizing the natural resources afforded him in Pennsylvania for the developing, to a greater extent, that time-honored line of animal industry—sheep husbandry. The vast verdue-covered mountains and steep hill sides, upon which the grasses grow luxuriantly, great bodies of which can be purchased at a moderate price, offer unexcelled inducements as a business venture. And these lands, too, are within a few hours ride of cities and centers of population, thus affording the advantage of home market, thereby eliminating largely the expense of transportation and cost of marketing. Attention is called to this situation, in the hope of encouraging, what in all ages has been the most profitable line of animal industry, but in Pennsylvania, at present, seems to be more neglected than all others.

Of the many problems confronting agriculture, probably no one is more difficult of solution than that of the procuring of efficient farm help. Great numbers of farmers' sons have been induced to leave the farm for what seemed to offer more remunerative reward for labor in manufacturing industries, business enterprises, etc., thereby causing much anxiety and close application on many farms, together with long hours of labor on the part of those remaining on the farm in order to properly cultivate the fields and safely store the crops.

Whilst traveling through the State during the harvest time, it was not unusual to see the farmers' daughters out in the harvest field, driving the binder and mowing machine and building loads of hay and grain. Thus the queens of the country home have demonstrated their sterling worth, and that to be useful in life should always accompany refinement and culture. The farm labor problem is very much relieved by the use of machinery. Such improvement has been made in this direction that the power of one man is greater than that of four men twenty years ago. The progressive and practical farmer is rapidly learning to so adjust his operations as to convenience of buildings, water supply and kindred surroundings, in order to economize labor and reduce to a minimum the waste in feeding stuffs; also the successful handling of manures made at the farmer's barn.

Some years since a careful investigation was made of the waste

going on in the average barn yard, by leaching out, washing away and heating. In a careful estimate the loss from these causes alone to the farmer amounted annually to over sixteen millions of dollars. As a result of careful teaching on the part of Farmers' Institutes during the past few years, great improvement has been made in the handling of this most valuable product of the farm—in the construction of the stable by using absorbents, and in better grading and cementing of the barn yard, thus preventing the leaching out and washing away of vast quantities of valuable fertility so urgently needed upon the farm. Even the casual observer cannot fail to notice the awakening of farmers through the medium of institutes. He is rapidly learning that upon the fertility of his soil depends his hope for an abundant and remunerative crop. The condition of his soil must be studied and known; its wants supplied, and the seed bed prepared properly with reference to the supplying of moisture and fertility (in solution) from which the plant may receive nourishment and bring forth fruitage.

So diversified is the farming of Pennsylvania, that no branch of animal industry can be omitted from the scope of topics discussed at our institutes. The dairy cow, her food, care and management; the barn, how ventilated in order to procure pure air and preserve a uniform temperature; the proportions of protein, carbohydrates and fat contained in feeds, in order to produce the greatest quantity of milk to a profit. Great numbers of cattle are being fed this winter for beef, and feeders are confronted with the problem of high priced corn (70 cents per bushel), hay ($14 per ton), oats (50 cents per bushel), with brans and concentrated foods correspondingly high; yet a reasonable profit seems to be in store for the feeder should beef continue to sell at present prices. Fruit growing is scarcely second in importance; vegetables and small fruits; the insects that prey upon them, how controlled and subdued. All of these vital problems are made the subject of careful consideration at our meetings. Hence the farmer, handling the things of nature, can only hope to succeed, in so far as his work is carried on, in strict conformity with the great natural laws which enter into soil fertility, plant growth, animal life, etc.

To the dissemination of such truths, scientific and practical, as will open up to his mind the best methods to be followed in his chosen lines of farm operations, is one of the important functions of the Farmers' Institutes. During the entire season of 1900-1901, there were held 335 days of institutes and 848 sessions, with an average attendance at each session of 170, and a total attendance of 144,328. The total cost, embracing hall rent, local management, advertising, etc., was $37.00 per day. Herewith is appended the dates and places, in the five different sections, where institutes were held, also names of

speakers supplied by the Department, who joined with the local people in the development of such information as seemed best adapted to the location.

PENNSYLVANIA FARMERS' INSTITUTES.

APPORTIONMENT FOR 1900-1901.

SCHEDULE OF DATES, PLACES AND ASSIGNMENTS OF LECTURERS BY SECTIONS.

FIRST SECTION.

Alva Agee and M. S. McDowell will attend all meetings in this section.

Date.	Place.	County.	Additional Lecturers.
Dec. 3,	Byers,	Chester,	C. D. Northrop.
Dec. 4-5,	New Holland,	Lancaster,	C. D. Northrop.
Dec. 6,	Cedarville,	Chester,	C. D. Northrop and Rev. J. D. Detrich.
Dec. 7-8,	Gap,	Lancaster,	C. D. Northrop; and Rev. J. D. Detrich, Dec. 7.
Dec. 10-11,	Coventryville,	Chester,	L. W. Lighty.
Dec. 12-13,	Quarryville,	Lancaster,	L. W. Lighty.
Dec. 14-15,	Unionville,	Chester,	L. W. Lighty.
Dec. 17-18,	Airville,	York,	W. F. McSparran.
Dec. 19-20,	Stewartstown,	York,	W. F. McSparran.
Dec. 21-22,	Hanover,	York,	W. F. McSparran.
Dec. 31--Jan. 1,	New Oxford,	Adams,	J. H. Peachy.
Jan. 2,	Fairfield,	Adams,	J. H. Peachy.
Jan. 3-4,	Arendtsville,	Adams,	J. H. Peachy.
Jan. 5,	Dickinson,	Cumberland,	J. H. Peachy.
Jan. 7-8,	Shippensburg,	Cumberland,	M. E. Conard.
Jan. 9,	Hoguestown,	Cumberland,	M. E. Conard.
Jan. 10-11,	Orrstown,	Franklin,	S. F. Barber.
Jan. 12,	Fayetteville,	Franklin,	S. F. Barber.
Jan. 14-15,	St. Thomas,	Franklin,	M. S. Bond.
Jan. 16,	Marion,	Franklin,	M. S. Bond.
Jan. 17,	Needmore,	Fulton,	M. S. Bond.
Jan. 18,	Buck Valley,	Fulton,	M. S. Bond.
Jan. 19,	Warfordsburg,	Fulton,	M. S. Bond.
Jan. 28-29,	Dillsburg,	York,	S. R. Downing.
Jan. 30-31,	Duncannon,	Perry,	S. R. Downing.
Feb. 1-2,	Blain,	Perry,	S. R. Downing.
Feb. 4-5,	East Salem,	Juniata,	T. O. Milliken.
Feb. 6-7,	Port Royal,	Juniata,	T. O. Milliken.
Feb. 8-9,	Somerset,	Somerset,	A. J. Kahler and C. L. Peck.
Feb. 11-12,	Elklick,	Somerset,	A. J. Kahler and C. L. Peck.
Feb. 13,	Berlin,	Somerset,	A. J. Kahler and C. L. Peck.
Feb. 14,	Buenavista,	Bedford,	Joel A. Herr.
Feb. 15-16,	Fishertown,	Bedford,	Joel A. Herr.
Feb. 20-21,	Friends' Cove,	Bedford,	Joel A. Herr.
Feb. 22-23,	Uniontown,	Fayette,	G. C. Felix.

Date.	Place.	County.	Additional Lecturers.
Feb. 25-26,	Tippecanoe,	Fayette,	G. C. Felix.
Feb. 27,	Merrittstown,	Fayette,	G. C. Felix.
March 1,	Westgrove,	Chester,	Speakers to be supplied.

SECOND SECTION.

Prof. S. B. Heiges will attend all meetings in this section.

Date.	Place.	County.	Additional Lecturers.
Dec. 3-4,	Parkwood,	Indiana,	M. N. Clark and W. H. H. Riddle.
Dec. 5-6,	Ambrose,	Indiana,	M. N. Clark and W. H. H. Riddle.
Dec. 7-8,	Richmond,	Indiana,	M. N. Clark and W. H. H. Riddle.
Dec. 10-11,	Hastings,	Cambria,	D. H. Pershing and Prof. J. M. Hantz.
Dec. 12-13,	South Fork,	Cambria,	D. H. Pershing and Prof. J. M. Hantz.
Dec. 14-15,	Marklesburg,	Huntingdon,	D. H. Pershing and Prof. J. M. Hantz.
Dec. 17-18,	Calvin,	Huntingdon,	F. E. Field and A. Judson Smith.
Dec. 19-20,	McVeytown,	Mifflin,	F. E. Field and A. Judson Smith.
Dec. 21,	Belleville,	Mifflin,	F. E. Field and A. Judson Smith.
Dec. 31-Jan. 1,	Martinsburg,	Blair,	Thos. J. Philips and A. P. Young.
Jan. 2-3,	Tyrone,	Blair,	Thos. J. Philips and A. P. Young.
Jan. 4-5,	Morrisdale,	Clearfield,	Thos. J. Philips and A. P. Young.
Jan. 7-8,	Woodland,	Clearfield,	R. L. Beardslee and J. S. Burns.
Jan. 9-10,	Port Matilda,	Centre,	R. L. Beardslee and J. S. Burns.
Jan. 11-12,	Centre Hall,	Centre,	R. L. Beardslee and J. S. Burns.
Jan. 14-15,	Middleburg,	Snyder,	H. V. White and T. O. Milliken
Jan. 16-17,	Mt. Pleasant Mills,	Snyder,	H. V. White and T. O. Milliken
Jan. 18-19,	Elysburg,	Northumberland,	H. V. White and T. O. Milliken
Jan. 28-29,	Mainville,	Columbia,	Frank Simpson and C. D. Northrop.
Jan. 30-31,	Bloomsburg,	Columbia,	Frank Simpson and C. D. Northrop.
Feb. 1,	Rohrsburg,	Columbia,	Frank Simpson and C. D. Northrop.
Feb. 2,	New Berlin,	Union,	Frank Simpson and C. D. Northrop.
Feb. 4-5,	Brook Park,	Union,	C. D. Northrop and W. H. Stout.
Feb. 6-7,	Watsontown,	Northumberland,	C. D. Northrop and W. H. Stout.
Feb. 8-9,	Pottsgrove,	Northumberland and Montour.	C. D. Northrop and W. H. Stout.
Feb. 11-12,	Exchange,	Montour,	A. Judson Smith and J. H. Peachy.
Feb. 13-14,	Linglestown,	Dauphin,	A. Judson Smith and J. H. Peachy.
Feb. 15-16,	Fisherville,	Dauphin,	A. Judson Smith and J. H. Peachy.
Feb. 20-21,	Lawn,	Lebanon,	W. F. McSparran and Calvin Cooper.
Feb. 22,	Schaeffertown,	Lebanon,	W. F. McSparran and Calvin Cooper.
Feb. 23,	Jonestown,	Lebanon,	W. F. McSparran and Calvin Cooper.
Feb. 25,	Pinegrove,	Schuylkill,	W. F. McSparran and O. D. Schock.
Feb. 26-27,	Orwigsburg,	Schuylkill,	W. F. McSparran and O. D. Schock.
Feb. 28,	Andreas,	Schuylkill,	W. F. McSparran and O. D. Schock.

THIRD SECTION.

Col. John A. Woodward and Prof. R. L. Watts will attend all meetings in this section.

Date.	Place.	County.	Additional Lecturers.
Dec. 3-4,	Bridgeville,	Allegheny,	Dr. I. A. Thayer and Miss Sarah A. Diem.
Dec. 5-6,	Centreville,	Washington,	Dr. I. A. Thayer and Miss Sarah A. Diem.
Dec. 7-8,	Amity,	Washington,	Dr. I. A. Thayer and Miss Sarah A. Diem.
Dec. 10-11,	Claysville,	Washington,	C. W. Williams.
Dec. 12-13,	Jefferson,	Greene,	C. W. Williams.
Dec. 14-15,	Nineveh,	Greene,	C. W. Williams.
Dec. 17-18,	Imperial,	Allegheny,	J. D. Buchanan and Mrs. Mary S. Parry.
Dec. 19-20,	Frankfort Springs,	Beaver,	J. D. Buchanan and Mrs. Mary S. Parry.
Dec. 21-22,	Darlington,	Beaver,	J. D. Buchanan and Mrs. Mary S. Parry.
Dec. 31-Jan. 1,	Hillsville,	Lawrence,	S. S. Brockway.
Jan. 2,	Plain Grove,	Lawrence,	S. S. Brockway.
Jan. 3,	Plain Grove,	Lawrence,	S. S. Brockway and Dr. I. A. Thayer.
Jan. 4,	Jackson Centre,	Mercer,	S. S. Brockway and Dr. I. A. Thayer.
Jan. 5,	Jackson Centre,	Mercer,	S. S. Brockway.
Jan. 7-8,	Hadley,	Mercer,	C. L. Peck.
Jan. 9-10,	Greenville,	Mercer,	C. L. Peck.
Jan. 11-12,	Espyville,	Crawford,	C. L. Peck.
Jan. 14-15,	Dicksonburg,	Crawford,	Geo. E. Hull.
Jan. 16,	West Springfield,	Erie,	Geo. E. Hull.
Jan. 17,	West Springfield,	Erie,	Geo. E. Hull and Dr. I. A. Thayer.
Jan. 18,	Harbourcreek,	Erie,	Geo. E. Hull and Dr. I. A. Thayer.
Jan. 19,	Harbourcreek,	Erie,	Geo. E. Hull.
Jan. 28-29,	Wattsburg,	Erie,	W. H. H. Riddle.
Jan. 30-31,	Centreville,	Crawford,	W. H. H. Riddle.
Feb. 1-2,	New Richmond,	Crawford,	W. H. H. Riddle.
Feb. 4-5,	Salina,	Venango,	J. S. Burns.
Feb. 6,	Cooperstown,	Venango,	J. S. Burns.
Feb. 7,	Cooperstown,	Venango,	J. S. Burns and Dr. I. A. Thayer.
Feb. 8,	Sunbury,	Butler,	J. S. Burns and Dr. I. A. Thayer.
Feb. 9,	Sunbury,	Butler,	J. S. Burns.
Feb. 11-12,	Winfield Grange,	Butler,	J. B. Johnston and S. R. Elder.
Feb. 13-14,	Portersville,	Butler,	J. B. Johnston and S. R Elder.
Feb. 15-16,	Talley Cavey,	Allegheny,	J. B. Buchanan.
Feb. 20-21,	Ruffsdale,	Westmoreland,	J. S. Burns.
Feb. 22,	Manor Station,	Westmoreland,	J. S. Burns.
Feb. 23,	Smithton,	Westmoreland,	J. S. Burns.
Feb. 25-26,	Apollo,	Armstrong and Westmoreland.	J. S. Burns.
Feb. 27-28,	Elderton,	Armstrong,	M. N. Clark and Mrs. Mary S. Parry.
March 1-2,	Worthington,	Armstrong,	M. N. Clark and Mrs. Mary S. Parry.

FOURTH SECTION.

R. J. Weld and Enos H. Hess will attend all meetings in this section.

Date.	Place.	County.	Additional Lecturers.
Dec. 3-4,	Gillett,	Bradford,	John McDonald.
Dec. 5-6,	Leroy,	Bradford,	John McDonald.
Dec. 7-8,	Wysox,	Bradford,	John McDonald.
Dec. 10-11,	Tunkhannock,	Wyoming,	F. E. Field.
Dec. 12-13,	Mill City,	Wyoming,	F. E. Field.
Dec. 14-15,	Forksville,	Sullivan,	F. E. Field.
Dec. 17-18,	Orwell Hill,	Bradford,	Thos. J. Philips.
Dec. 19-20,	Hughesville,	Lycoming,	Thos. J. Philips.

Date.	Place.	County.	Additional Lecturers.
Dec. 21,	Eagle Grange Hall,	Lycoming,	Thos. J. Philips.
Dec. 22,	W. Branch Grange,	Lycoming,	Thos. J. Philips.
Dec. 31,	Warrensville,	Lycoming,	C. W. Brodhead.
Jan. 1,	Phelps' Chapel,	Clinton,	C. W. Brodhead.
Jan. 2-3,	Wellsboro,	Tioga,	C. W. Brodhead.
Jan. 4-5,	Tioga,	Tioga,	C. W. Brodhead.
Jan. 7,	Nauvoo,	Tioga,	L. W. Lighty.
Jan. 8,	Mansfield,	Tioga,	L. W. Lighty.
Jan. 9,	Germania,	Potter,	L. W. Lighty.
Jan. 10,	Harrison City,	Potter,	L. W. Lighty.
Jan. 11,	Genesee,	Potter,	L. W. Lighty.
Jan. 12,	Millport,	Potter,	L. W. Lighty.
Jan. 14,	Roulette,	Potter,	L. W. Lighty.
Jan. 15-16,	Port Alleghany,	McKean,	A. P. Young.
Jan. 17-18,	Smethport,	McKean,	A. P. Young.
Jan. 18-29,	Warren,	Warren,	Geo. E. Hull.
Jan. 30,	Columbus,	Warren,	Geo. E. Hull.
Jan. 31,	Columbus,	Warren,	Geo. E. Hull and Dr. I. A. Thayer.
Feb. 1,	Clarington,	Forest,	Geo. E. Hull and Dr. I. A. Thayer.
Feb. 2,	Clarington,	Forest,	Geo. E. Hull.
Feb. 4,	Marionville,	Forest,	Frank Simpson.
Feb. 5-6,	Salem,	Clarion,	Frank Simpson.
Feb. 7-8,	Reimersburg,	Clarion,	Frank Simpson.
Feb. 11-12,	Piollet,	Clarion,	W. H. H. Riddle.
Feb. 13,	Richardsville,	Jefferson,	W. H. H. Riddle.
Feb. 14-15,	Stanton,	Jefferson,	W. H. H. Riddle.
Feb. 16,	Paradise,	Jefferson,	W. H. H. Riddle.
Feb. 20,	Weedville,	Elk,	R. L. Beardslee.
Feb. 21,	Centreville,	Elk,	R. L. Beardslee.
Feb. 22-23,	St. Marys,	Elk,	R. L. Beardslee.
Feb. 25-26,	Emporium,	Cameron,	R. L. Beardslee.
Feb. 27,	Driftwood,	Cameron,	R. L. Beardslee.
Feb. 28,	Salona,	Clinton,	R. L. Beardslee.
March 1,	Lamar,	Clinton,	R. L. Beardslee.

FIFTH SECTION.

Robert S. Seeds and Prof. George C. Butz will attend all meetings in this section.

Date.	Place.	County.	Additional Lecturers.
Dec. 3,	Madisonville,	Lackawanna,	Geo. Campbell.
Dec. 4,	Clark's Summit,	Lackawanna,	Geo. Campbell.
Dec. 5,	Bald Mount,	Lackawanna,	Geo. Campbell.
Dec. 6,	Fleetville,	Lackawanna,	Geo. Campbell.
Dec. 7,	Auburn Centre,	Susquehanna,	Geo. Campbell.
Dec. 8,	Montrose,	Susquehanna,	Geo. Campbell.
Dec. 10,	Brooklyn,	Susquehanna,	John McDonald.
Dec. 11,	New Milford,	Susquehanna,	John McDonald.
Dec. 12,	Welshhill,	Susquehanna,	John McDonald.
Dec. 13,	Uniondale,	Susquehanna,	John McDonald.
Dec. 14,	Sherman,	Wayne,	John McDonald.
Dec. 15,	Winwood,	Wayne,	John McDonald.
Dec. 17,	Pleasant Mount,	Wayne,	R. F. Schwarz.
Dec. 18,	Farno,	Wayne,	R. F. Schwarz.
Dec. 19,	Bethany,	Wayne,	R. F. Schwarz.
Dec. 20,	South Canaan,	Wayne,	R. F. Schwarz.
Dec. 21,	Milford,	Pike,	R. F. Schwarz.
Dec. 22,	Dingman's Ferry,	Pike,	R. F. Schwarz.
Dec. 31-Jan. 1,	Souderton,	Montgomery,	W. F. McSparran.
Jan. 2-3,	Springtown,	Bucks,	W. F. McSparran; and J. D. Detrich, Jan. 3.
Jan. 4,	Lower Saucon,	Northampton,	W. F. McSparran and J. D. Detrich.
Jan. 5,	Hecktown,	Northampton,	W. F. McSparran.
Jan. 7-8,	Moorestown,	Northampton,	J. Q. Atkinson.
Jan. 9-10,	Mt. Bethel,	Northampton,	J. Q. Atkinson.
Jan. 11-12,	Gilbert,	Monroe,	J. Q. Atkinson.
Jan. 15,	Horticultural Hall,	Philadelphia,	J. D. Nevins, J. D. Detrich and L. A. Clinton.
Jan. 16-17,	Bustleton,	Philadelphia,	J. D. Nevins, L. A. Clinton; and J. D. Detrich, Jan. 16.
Jan. 18-19,	Northampton,	Bucks,	J. D. Nevins and L. A. Clinton.
Jan. 28-29,	Concordville,	Delaware,	W. A. Hutchison.
Jan. 30-31,	Manor,	Delaware,	W. A. Hutchison
Feb. 1-2,	Middletown Grange,	Bucks,	W. A. Hutchison.
Feb. 4-5,	Hatboro,	Montgomery,	C. W. Brodhead.
Feb. 6-7,	Centre Point,	Montgomery,	C. W. Brodhead.
Feb. 8,	Wrightstown,	Bucks,	C. W. Brodhead.

Date.	Place.	County.	Additional Lecturers.
Feb. 11-12,	Boyerstown,	Berks,	Dr. M. E. Conard and Jasper T. Jennings.
Feb. 13-14,	Geiger's Mills,	Berks,	Dr. M. E. Conard and Jasper T. Jennings.
Feb. 15-16,	Blandon,	Berks,	Dr. M. E. Conard and Jasper T. Jennings.
Feb. 20,	Kempton,	Berks,	L. W. Lighty.
Feb. 21-22,	Jacksonville,	Lehigh,	L. W. Lighty.
Feb. 23,	East Texas,	Lehigh,	L. W. Lighty.
Feb. 25-26,	Cedarville,	Lehigh,	L. W. Lighty.
Feb. 27-28,	Craig's Meadows,	Monroe,	H. W. Northup.
March 1,	New Mahoning,	Carbon,	H. W. Northup.
March 2,	Weatherly,	Carbon,	H. W. Northup.
March 4,	Carverton,	Luzerne,	Jason Sexton.
March 5,	Lehman,	Luzerne,	Jason Sexton.
March 6-7,	Conyngham,	Luzerne,	Jason Sexton.

The general prosperity attending farm operations the past year has stimulated and encouraged the country agricultural societies of the State in holding their annual fairs, complete reports from which show a great increase in the exhibit of all kinds of live stock, fruits, vegetables and cereals. The attendance at these exhibitions in 1900 were over 1,143,071; and premiums paid, $110,830.60. Thirty-nine of the societies holding fairs in 1901 offered a total in premiums of $133,-350.00. Forty-seven of these societies have one-half mile race track and seven one-third mile track.

Whilst visiting many of these associations, at the time of their exhibitions, in order to gain such information as would be of advantage to the agricultural interests of the State, I noted some of the conditions and management of these fairs. A great improvement has taken place in the way of offering better premiums for all lines of live stock, which is commendable; also in the appointment of judges for stock. Many of these societies are striving to secure one expert judge who is qualified and capable to decide upon the merits of competing animals, or articles, in conformity with established rules and regulations governing the same. This action is to be commended, by thus relieving the awarding of premiums from the odium of favoritism which might some times be charged against persons serving, who are acquainted with the exhibitors. Tests of speed on race courses is to be commended; yet we note that at some of these fairs, pool-selling and other modes of gambling occupy a prominent place near the judges' stand. This action cannot be condemned in language too strong or forcible. In order that these agricultural societies may fill the place in agriculture that they are intended, the standard of morality and the principles of obeying the laws of the State, ought, of necessity, to be strictly complied with. We speak for the agricultural societies of the State a prosperous future, conditioned upon the principle of conducting these exhibitions in such a manner as to give the greatest encouragement to every line of agricultural exhibit, and discouraging what would seem to be a preponderance of side shows, games of chance, etc., which tend to lead the minds of the young away from habits of industry and sobriety.

Following is a list of county and local Agricultural Societies which held exhibitions in 1901:

County.	Corporate Name of Society.	Attendance 1900.	Race track.	Premiums. Paid 1900.	Premiums. Offered 1901.	Where Held 1901.	When Held 1901.
	Pennsylvania State Agricultural Society,	35,311	Yes,	$4,354 13		Lancaster,	Oct. 1-4.
	Grangers' Picnic Exhibition,	120,000	No,			Williams Grove,	Aug. 26-31.
	Mt. Gretna Agricultural, Mechanical and Industrial Exposition.		No,			Mt. Gretna,	Aug. 19-23.
	Patrons of Husbandry Exhibition,	10,000	No,		Pay none,	Grange Park, Centre Hall.	Sept. 16-20.
Armstrong,	Dayton Agricultural and Mechanical Association.	13,000	1-3 mile,	1,500 00		Dayton,	Sept. 24-27.
Beaver,	Mill Creek Valley Agricultural Association, Limited.		1-3 mile,	2,155 00		Hookstown,	Aug. 20-22.
Bedford,	Bedford County Agricultural Society,	5,000	½ mile,	1,000 00	1,000 00	Bedford,	Oct. 1-3.
Berks,	Agricultural and Horticultural Association of Berks County.	40,000	½ mile,	2,000 00	5,000 00	Reading,	Oct. 1-4.
Berks,	Keystone Agricultural and Horticultural Society.	20,000	1-3 mile,	1,200 00	1,800 00	Kutztown,	Sept. 17-20.
Blair,	Blair County Agricultural Society,	15,000	½ mile,	Including race purses, $1,500.00.	Same as 1900,	Hollidaysburg,	Sept. 10-13.
Bradford,	Bradford County Agricultural Society,	25,000	½ mile,	1,500 00	$2,800 premiums, $850 purses.	E. Towanda Fair Grounds.	Sept. 24-27.
Bradford,	Union Agricultural Association,	3,000	½ mile,	316 17	1,200 00	Canton,	Sept. 10-13.
Bradford,	Troy Agricultural Society,	6,000	½ mile,	664 90	1,400 00	Troy,	Sept. 17-20.
Butler,	Butler County Agricultural Society,	24,000	½ mile,	2,528 00	4,000 00	Butler,	Sept. 3-6.
Cambria,	Ebensburg Agricultural Society,	8,000	½ mile,	1,200 00	1,500 00	Ebensburg,	Aug. 27-30.
Carbon,	Carbon County Industrial Society,	8,000	½ mile,	550 00		Lehighton,	Sept. 17-20.
Centre,	Centre County Agricultural Exhibiting Company.	10,000	½ mile,	4,500 00	4,800 00	Bellefonte,	Sept. 10-13.
Chester,	Oxford Agricultural Society,	6,000	½ mile,	$1,000.00 and speed premiums.	Same as 1900,	Oxford,	Sept. 25-27.
Clarion,	Clarion County Fair Association,	12,000	½ mile,			Clarion,	Sept. 3-6.
Columbia,	Columbia County Agricultural, Horticultural and Mechanical Association.	25,000	½ mile,	5,100 00	6,000 00	Bloomsburg,	Oct. 8-11.
Crawford,	Central Crawford Agricultural Society,	12,000	1-3 mile,	809 74		Cambridge Springs,	Aug. 27-30.
Cumberland,	Cumberland County Agricultural Society,	20,000	½ mile,	4,000 00	4,000 00	Carlisle,	Sept. 24-27.
Dauphin,	Gratz Agricultural and Horticultural Association.		½ mile,			Gratz,	Aug. 20-23.

Erie,	Edinboro Agricultural Association,	40,000	½ mile,..	150 00	550 00	Edinboro,	Aug. 13-16.
Fayette,	Fayette Fair Association,	12,000	½ mile,..	2,000 00	2,500 00	Uniontown,	Oct. 1-4.
Greene,	Waynesburg Fair Association,	15,000	½ mile,..			Waynesburg,	Sept. 17-20.
Greene,	Greene County Agricultural and Mechanical Society.		1-3 mile,.	468 00	600 00	Carmichaels,	Oct. 2-3.
Greene,	Richhill Agricultural Society,	1,500	1-3 mile,.	400 00	500 00	Wind Ridge,	Sept. 4-5.
Indiana,	Indiana County Agricultural Society,		½ mile,..			Indiana,	Sept. 10-13.
Jefferson,	Punxsutawney Fair Association,	18,000	½ mile,..	8,000 00	8,000 00	Punxsutawney,	Aug. 27-29.
Juniata,	Juniata County Agricultural Society,	10,000	½ mile,..	1,500 00		Port Royal,	Sept. 11-13.
Lebanon,	Lebanon Valley Fair Association,		½ mile,..			Lebanon,	Sept. 3-6.
Lehigh,	Lehigh County Agricultural Society,	200,000	½ mile,..	14,000 00	20,000 00	Allentown,	Sept. 23-28.
Luzerne,	Dallas Union Agricultural Society,	15,000	½ mile,..	1,500 00		Dallas,	Oct. 1-4.
Lycoming,	Muncy Valley Farmers' Club,	12,000	½ mile,..	1,850 00	1,850 00	Hughesville,	Sept. 17-20.
Mercer,	Mercer County Agricultural Society,	28,000	½ mile,..	Including speed 3,600 00	4,500 00	Stoneboro,	Oct. 1-3.
Mercer,	Mercer Central Agricultural Society,	12,000	½ mile,..	2,300 00	2,300 00	Mercer,	Sept. 24-26.
Northampton,	Northampton County Agricultural Association,..	60,000	½ mile,..	4,223 58	5,000 00	Nazareth,	Oct. 1-4.
Northampton,	Pennsylvania State Fair Association,	45,000	½ mile,..	2,600 00	4,000 00	Bethlehem,	Sept. 10-13.
Northumberland,	Milton Driving Park and Fair Association,	40,000	½ mile,..	1,600 00	1,600 00	Milton,	Oct. 1-4.
Perry,	Perry County Agricultural Society,	6,000	½ mile,..	Including races $1,600.00.	Including race purses, $1,800.	Newport,	Sept. 17-19.
Philadelphia,	Pennsylvania Horticultural Society,	2,000		$1,900 00	$1,950 00	Horticultural Hall, Philadelphia.	Nov. 12-16.
Schuylkill,	Orwigsburg Agricultural and Horticultural Society.	15,000	½ mile,..	400 00		Orwigsburg,	Sept. 10-13.
Sullivan,	Sullivan County Agricultural Society,	5,000	No,	272 05	600 00	Forksville,	Oct. 2-4.
Susquehanna,	Susquehanna County Agricultural Society,	5,000	No,	800 00	800 00	Montrose,	Oct. 1-2.
Susquehanna,	Harford Agricultural Society,	6,000	No,	950 00	1,100 00	Harford,	Sept. 25-26.
Tioga,	Cowanesque Valley Agricultural Society,	15,000	½ mile,..	1,500 00	2,000 00	Westfield,	Sept. 9-13.
Tioga,	Smythe Park Association,		No,			Mansfield,	Sept. 24-27.
Union,	Union County Agricultural Society,	15,000	½ mile,..	Race, $2,150; premiums, $900.00.	Same as 1900,...	Lewisburg,	Sept. 24-27.
Washington,	Western Pennsylvania Agricultural Association,	11,260	½ mile,..	Premiums and purses, $4,689.88.	Premiums and purses, $12,000.	Washington,	Sept. 24-27.
Washington,	Union Agricultural Association,	12,000	1-3 mile,.	3,479 65	4,000 00	Burgettstown,	Oct. 1-3.
Wayne,	Wayne County Agricultural Society,	7,500	½ mile,..	1,250 00	1,800 00	Honesdale,	Sept. 24-26.
Westmoreland,	Westmoreland Agricultural Society,	11,000	½ mile,..	2,800 00		Youngwood,	Sept. 17-19.
Wyoming,	Wyoming County Agricultural Society,	6,000	½ mile,..	1,000 00	1,[illegible]	Tunkhannock,	Sept. 18-20.
York,	York County Agricultural Society,	50,000	½ mile,..	Premiums, $1,671.30; speed, $3,195.00.	6,[illegible]	York,	Oct. 7-11.
York,	Hanover Agricultural Society,	22,000	½ mile,..	1,200 00	2,000 00	Hanover,	Sept. 17-20.

PRICES OF AGRICULTURAL PRODUCTS.

In the matter of crop reports, and prices received by the farmers in the different counties of the State, the following table will show that in most of the crops cultivated, fair and remunerative prices have been maintained. Extremely dry weather in many sections, at the time the early potatoes were growing, cut the crop short; later rains in the different counties caused a rapid growth, early maturity and ripening of the late-planted potato, which was followed by rot, destroying many thousands of bushels after having been grown and harvested; the figures will, however, show a liberal price per bushel for those that were marketed.

The ravages of the Hessian Fly in the wheat were not so destructive as the year previous, and farmers are receiving advanced price for this cereal; and had the price of the different crops been collected some months later, the average would no doubt have been much higher than this table shows for all farm products. The following table presents the average market price for the various products, as well as the price of farm labor, wages, etc.:

Wheat, per bushel,	$0 71
Corn, per bushel,	58
Oats, per bushel,	41
Rye, per bushel,	58
Buckwheat, per bushel,	55
Hay, clover, per ton,	10 81
Hay, timothy, per ton,	13 30
Horses, per head,	98 00
Mules, per head,	101 00
Cows, per head,	32 00
Lambs, per head,	3 11
Ewes, per head,	3 48
Steers, fat, per pound,	5
Steers for feeding, per pound,	3
Swine, shoats, per pound,	6
Fat hogs, per pound,	6
Chickens, dressed, per pound,	12
Chickens, live, per pound,	8
Apples, per bushel,	75
Peaches, per basket,	72
Pears, per bushel,	93
Plums, per quart,	7
Cherries, per quart,	7
Blackberries, per quart,	7

Raspberries, per quart,	8
Potatoes, per bushel,	75
Butter, per pound, at store,	20
Butter, per pound, at market,	22
Milk, wholesale, 100 pounds,	1 15
Milk, retail, per quart,	5
Eggs, per dozen,	18
Wool, short, unwashed,	16
Wool, short, washed,	21
Wool, medium, unwashed,	17
Wool, medium, washed,	22
Wool, long, unwashed,	18
Wool, long, washed,	23
Farm land, improved, per acre,	58 00
Farm land, average, per acre,	38.00
Farm wages, by year, with board,	168 00
Farm wages, for summer months only,	18 00
Farm wages, by day, with board,	92
Farm wages, by day, without board,	1 23
Farm wages, whole year, without board,	260 00
Farm wages, harvest, by day,	1 39
Household help, female, with board, per week,.	2 19

The Legislature of 1901, recognizing the vast interests which are involved in agriculture, and the importance of encouraging and fostering the industry, at the request and petition of farmers from every county of the State, wisely passed an act increasing the appropriation for Farmers' Institutes to fifteen thousand dollars per annum, thereby enabling the Department to increase for the coming year the number of meetings; also to add new and important features, such as illustrating on canvas the life and habits of birds and insects, and showing us which of these are our friends and which are our foes; also illustrated lectures on forestry and showing its relation to the water supply, soil moisture and other kindred topics of vital importance to successful farm operations. The institute is now the farmer's school, to which he comes after the year's work upon the farm, having his mind filled with problems which can only be solved by the light of science as applied to agriculture. From a knowledge of chemistry, botany and etymology, as applied to agriculture, the Farmers' Institute is becoming a great medium through which lessons therein are reduced to practical application and carried to the farmer.

Respectfully submitted,

A. L. MARTIN,

Deputy Secretary and Director of Institutes.

REPORT OF THE DAIRY AND FOOD COMMISSIONER.

Harrisburg, Pa., January 1, 1902.

Hon. John Hamilton, *Secretary of Agriculture:*

My Dear Sir: I have the honor to make the following report of the work of the Dairy and Food Division of the Department of Agriculture, for the year 1901.

We have had in employment the usual number of agents, chemists and attorneys during the year. There has been collected by our agents, and analyzed by our chemists and reported to the Division, 2,007 samples of the several food products, which are upon the markets of the State. Of this number, 1,152 samples have been found to be true to name, or properly labeled, and 855 samples were found to be adulterated, or not properly labeled. Under the oleo act, there were issued 227 licenses, and we have received and paid into the State Treasury, $21,606.00 for the same. In the enforcement of this act, we have had collected and analyzed 903 samples. Of this number, 391 samples were found to be pure butter and 512 samples were found to be oleo. We have prosecuted 353 cases, and of this number, there were terminated 87 cases; there are still pending, 266 cases. Prosecutions were ordered before the close of the year upon 159 cases, but as we had difficulty in getting a magistrate, they were delayed and could not be entered upon this report. We have collected and paid into the State Treasury under this act, $7,567.84 in fines and costs. There are still in the hands of the sheriffs of the several counties of the State, about $3,500.00, which is being held until the question of the right to deduct from this amount the sheriff's fees is determined.

We have experienced considerable difficulty in some sections of the State in our efforts to enforce the law, owing to the public sentiment being in opposition to it. In the month of June there were ignored by the grand jury of Allegheny county, 123 bills and the costs placed upon the county. In the month of September there were 394 bills ignored by the grand jury of the aforesaid county, and the costs placed upon our agent, James Terry. This action was opposed by us, but to no avail, and I beg leave to call your attention to the copies of petitions to the court, which are included in this report. These peti-

tions were refused. We then, after sentence was imposed upon the agent, and procuring security for the payment of the costs, appealed the cases to the Superior Court (April term No. 96), where they are now pending. After an unsuccessful attempt in petitioning the court to restrain the sheriff from collecting the costs, they were paid under protest. The appeal to the Superior Court was for the purpose of having decided the right of a grand jury to place the costs upon a public officer, who had acted only in the performance of his duty under the law.

We have found that manufacturers beyond the State borders have been, for the purpose of evading the law, establishing places of business in certain sections of the State, having an agent take orders for oleo from customers and sending the order to the manufacturers beyond the State borders, where they are filled and shipped in their own cars to the houses in the State and there delivered by the agents. By detecting and prosecuting these agents we have succeeded to some extent in checking this method and hope to successfully put a stop to this traffic. To more successfully enforce the law in the larger cities, we have placed in the hands of the magistrates a docket, prepared by our attorney, and we hope by this means to be able to check appeals and certioraries of cases to court.

Pure Food Act.

In the enforcement of this act, we have had collected and analyzed by our chemists, 710 samples, and of this number, 475 samples were found to be pure, or properly labeled, and 235 samples were found to be adulterated or not properly labeled. We have prosecuted 183 cases, and of this number, 82 cases have been terminated and 101 cases are still pending owing to appeals and postponements. We have collected and paid into the State Treasury $4,883.23 in fines and costs.

There was, after the most careful consideration, compiled and placed in the hands of the trade, Bulletin No. 80, "Rulings, Definitions and Standards of Food Products." This work has been of valuable assistance to us in the discharge of our official duties. Manufacturers are now making an honest effort to have their products upon the markets of the State branded to comply with the requirements of the law. In the beginning of the year, our agents found the branding of certain articles were not in compliance with the requirements of the law, but at this date manufacturers, in general, appear to be making an effort to have these articles properly branded.

We have found that the use of preservatives in foods is being practiced to a very large extent. In our investigations we find that

this is so, not only in vegetables, but is also found in meats, oysters and even in dairy butter. This condition should not be permitted to continue, and if after a test before courts our present law is found to be inadequate, our next Legislature should be asked to so amend it that this growing practice can at least be regulated if not wholly prohibited.

Milk Act.

Under this act we have collected and analyzed 293 samples. Of this number, 237 samples were found to be unadulterated, or pure, and up to standard, and 56 samples were found to be adulterated or skimmed, and a few samples were found to contain a preservative. There were prosecuted 41 cases and there are still pending 15 cases. As it was necessary to bring some of these cases under the Pure Food Act, it is impossible for us to give the amount collected in fines and costs on these cases. In some of the cities we have found that a system is in practice among dealers which should be condemned; that is in drawing and serving milk by means of a stop-cock or spigot from the bottom of the can. This is unfair, as by this system patrons do not have fair service. The patrons of these cities should combine and put a stop to this practice.

Cheese Act.

Under this act we have collected and had analyzed by our chemists, 16 samples, and of this number, 11 samples were found to be up to standard or properly branded, and 5 samples were found to be not up to standard. At the last session of the Legislature, this act was so amended that the branding of this article cuts a very small figure.

Vinegar Act.

Under this act there have been collected by our agents and analyzed by our chemists, 35 samples, and of this number, 25 samples were found to be pure and 10 samples to be not pure. At the last session of the Legislature, this act was so amended that if the sample is found to be of the product of the apple, it will be in compliance with the law.

Fruit Juice Act.

This is a new act. Under this act we have prosecuted no cases, as it requires a guilty knowledge before prosecution can be brought.

Renovated Butter Act.

Under this act there have been issued 2 licenses, and we have received and paid into the State Treasury $175.00 for the same. We

have collected and analyzed by our chemists, 42 samples. Of this number, 19 samples were found to be properly branded, and 23 samples were found to be cases for prosecution, of this number, judgment was given in three cases, which have been appealed to court.

Lard Act.

Under this act we have collected and had analyzed 8 samples; of this number, four samples were found to be pure and four samples were found to be compound and not so labeled.

To more fully explain the workings of this Division, I have attached to this report the following tables:

Table No. 1, giving the number and showing the condition as to the purity of the samples collected by the agents, analyzed by the chemists and reported to the Division during the year. It must be remembered that the agents are instructed to omit from their samples such goods as previous analysis has shown to be pure.

Table No. 2, giving the number of samples collected under the act, giving the number that were found to be pure or up to standard or properly labeled, those found to be not pure or adulterated or not up to standard; also giving the number of samples collected and analyzed in total.

Table No. 3, giving the number of suits and prosecutions which were commenced, the number which have been terminated and the number still pending on appeal or *certiorari*; also giving the number of cases which were commenced previous to and terminated during the year.

TABLE NO. 1.

Which Gives the Number and Shows the Condition as to the Purity of the Samples Collected.

Allspice, pure,	3
Apple butter, adulterated,	2
Apple jelly, pure,	1
Asparagus tips, pure,	1
Assorted candy, pure,	2
Baked beans, pure,	2
Baking powder, pure,	15
Beans, pure,	4
Blackberries, pure,	1
Buckwheat flour, pure,	3
Butter, pure,	376
Butter, renovated,	42
Butter, oleo, colored,	512
Butter, oleo, uncolored,	15
California lemon sugar, pure,	3
California orange sugar, pure,	3
Calf's foot jelly, pure,	1
Canned beans, adulterated,	1
Canned corn, adulterated,	2
Canned peas, pure,	3
Canned peas, adulterated,	6
Canned oysters, adulterated,	1
Canned strawberries, pure,	1
Caramel butter, pure,	1
Catsup, pure,	23
Catsup, adulterated,	7
Cayenne pepper, pure,	6
Cayenne pepper, adulterated,	2
Cheese, pure,	11
Cheese, adulterated,	5
Cherry syrup, adulterated,	1
Chocola,	1
Chocolate, pure,	16
Chocolate, adulterated,	13
Cider, pure,	1
Cinnamon, pure,	16
Cloves, pure,	2
Cloves, adulterated,	1
Cocoa, pure,	2[illegible]
Cocoa, adulterated,	13
Coffee, pure,	14
Coffee essence, pure,	1
Coloring matter,	11
Condensed milk, pure,	29
Condensed milk, adulterated,	6
Cream, pure,	5
Cream-of-tartar, pure,	17
Cream-of-tartar, adulterated,	3
Cream, thick,	2
Currant jelly, pure,	1
Flaked rice, pure,	1
French capers, pure,	1
Fruit acid, pure,	1
Fruit syrup, pure,	4
Garantose, pure,	1
Gelatin, pure,	2
Gelatina, pure,	1
Ginger, pure,	7
Gooseberry jam, adulterated,	2
Grape butter, adulterated,	1
Grape juice, pure,	3
Grape juice, adulterated,	1
Gum benzoine, pure,	1
Honey, pure,	6
Honey, adulterated,	4
Ice cream, pure,	3
Iceine, pure,	1
Jelly Com., pure,	1
Jello, pure,	1
Ko-Ko Brown, pure,	1
Lard, pure,	4
Lard, adulterated,	4
Lemonade, pure,	1
Lemonade tablets, pure,	2
Lemon extract, pure,	33
Lemon extract, adulterated,	53
Licorice, pure,	1
Lime juice, pure,	1
Mace, pure,	1
Malt Breakfast Food, pure,	1
Maple syrup, pure,	9
Maple syrup, adulterated,	6
Milk, pure,	232
Milk, adulterated,	56
Milk chocolate, pure,	1
Molasses, pure,	1
Mustard, pure,	1
Noodles, pure,	2
Olive oil, pure,	1
Olive oil, adulterated,	2
Oraline, pure,	1
Orangeade, pure,	1
Orange extract, pure,	4
Orange extract, adulterated,	6
Orange marmalade, pure,	1
Orange syrup, pure,	2
Oysters (tubbed), pure,	61
Oysters (tubbed), adulterated,	2[illegible]
Peach butter, pure,	1
Peach preserves, adulterated,	1
Peanutine, pure,	1
Pepper, pure,	3[illegible]
Pepper, adulterated,	18
Pineapple extract, adulterated,	2
Pineapple juice, pure,	1
Plum jam, pure,	1
Poison tablets,	1
Preservaline,	4
Preserved butter,	2
Preserves, pure,	1
Quince jelly, pure,	1
Quince preserves, adulterated,	1
Raspberry extract, adulterated,	1
Raspberry jam, pure,	4
Raspberry jam, adulterated,	2
Raspberry jelly, pure,	2
Raspberry jelly, adulterated,	1
Raspberry juice, pure,	1
Raspberry preserves, pure,	1
Raspberry syrup, pure,	2
Salad oil, pure,	1
Salt, pure,	1
Salt pork, pure,	1
Sarsaparilla syrup, pure,	1
Sausage, pure,	4
Sausage, preserved,	13
Sheba butter, pure,	1
Soda water tablets, pure,	1
Strawberry extract, adulterated,	3
Strawberry fruit syrup, adulterated,	1
Strawberry jam, pure,	1
Strawberry juice, pure,	1
Strawberry preserves, pure,	1
Strawberry syrup, pure,	1
Strawberry syrup, adulterated,	1
Sugar, pure,	1
Sugarine, pure,	1
Table jelly, pure,	1
Vanilla extract, pure,	49
Vanilla extract, adulterated,	29
Vanishine, pure,	1
Vinegar, pure,	25
Vinegar, adulterated,	10
White pepper, pure,	1
White pepper, adulterated,	1
	2,0[illegible]7

TABLE NO. 2.

Which Gives the Number of Samples Taken and Analyzed Under the Several Acts.

Number of butter samples which proved to be oleo,	5[illegible]2
Number of butter samples which proved to be renovated,	42
Number of butter samples which proved to be pure,	3[illegible]1
Total number of butter samples analyzed,	[illegible]
Number of food samples which proved to be pure,	475
Number of food samples which proved to be adulterated,	2[illegible]5
Total number of food samples analyzed,	71[illegible]
Number of milk samples which proved to be pure,	237
Number of milk samples which proved to be adulterated,	5[illegible]
Total number of milk samples analyzed,	29[illegible]
Number of vinegar samples which proved to be up to standard,	[illegible]
Number of vinegar samples which proved to be not up to standard,	1[illegible]
Total number of vinegar samples analyzed,	[illegible]
Number of cheese samples which proved to be up to standard,	11
Number of cheese samples which proved to be not up to standard,	5
Total number of cheese samples analyzed,	16
Number of lard samples which proved to be pure,	4
Number of lard samples which proved to be compound,	4
Total number of lard samples analyzed,	8
Total number of samples analyzed during the year,	2,[illegible]07

TABLE NO. 3.

Which Gives the Number of Suits and Prosecutions Commenced, Terminated and Pending. Also Cases Commenced Previous to and Terminated During the Year 1901.

Cases Commenced During the Year 1901.

	Prosecuted.	Terminated.	Pending.
Under oleomargarine act of 1899,	295	62	233
Under oleomargarine act of 1901,	58	25	33
Under renovated butter act of 1901,	23	3	20
Under pure food act of 1895,	183	82	101
Under milk act of 1901,	41	16	25
Under cheese act,	3	1	2
Under vinegar act of 1897,	[illegible]	[illegible]	3

Cases Commenced Previous to and Terminated During the Year 1901.

	Terminated.
Under oleomargarine act of 1899,	153
Under renovated butter act of 1899,	1
Under pure food act of 1895,	11

In connection with this number, there were 394 oleo bills ignored by the grand jury of Allegheny county, but as those cases have been appealed to the Superior Court, they are still pending and their number cannot be included in this report. There were also, as has been before referred to, a number of cases upon which prosecution has been ordered, but as they could not be brought forward they are not included in this report.

Very respectfully,

JESSE K. COPE,
Dairy and Food Commissioner.

IN THE COURT OF QUARTER SESSIONS OF ALLEGHENY COUNTY.

Commonwealth of Pennsylvania
vs.
S. B. Charters, et al.
} No. 641, September Term, 1901.

PETITION OF JAMES TERRY, Prosecutor.

To the Honorable the Judges of said Court:

The petition of James Terry respectfully represents:

That he is the agent of the Dairy and Food Commissioner of the Commonwealth of Pennsylvania, employed in such capacity for a number of years, and engaged in the performance of his duties as such public officer during the year 1900, and is so engaged at this time.

That among other responsibilities devolving upon him as such officer, it is his duty to ascertain information and prosecute on behalf of the Commonwealth, all cases involving the violation of an act of the General Assembly, entitled "An act providing for the regulation and sale of oleomargarine, etc., approved May 5, 1901."

That on the 1st day of September, S. B. Charters had in his possession with intent to sell, offered for sale and sold at his place of business in the city of Pittsburg, county of Allegheny and State of Pennsylvania, a certain quantity of a substance commonly known as oleomargarine; that said substance upon being purchased by George H. Wilcox, one of the agents of the Dairy and Food Commissioner aforesaid, was placed in the hands of F. T. Aschman, a chemist, and by him analyzed and found to be oleomargarine, colored in imitation of yellow butter; that said sale so made as aforesaid, was in violation of the act of Assembly above mentioned; that in proof of said violation of law aforesaid, an indictment was presented to the grand jury of Allegheny county, based upon an information made in this behalf by your petitioner, and upon a hearing had upon such indictment by and in the presence of the grand jury of Allegheny county on the 20th day of September, 1901, the following named witnesses were called, sworn and examined, to-wit: James Terry, informant, George H. Wilcox, who purchased said oleomargarine from defendant and Prof. F. T. Aschman, the chemist by whom the same was analyzed; that said witnesses specifically stated in the presence of said grand jury, as your petitioner is informed and believes, the acts upon which the information in this case was based and for which an indictment was asked; the substance of the testimony of the witnesses aforesaid, being more particularly set out in affidavits hereto attached and made part hereof; that notwithstanding the specific nature of the allegations and the testimony produced in support of the same, upon which your petitioner believes it was the duty of the grand jury to return to this court a true bill, yet the grand jury aforesaid, wholly disregarding its duty in the premises and ignoring the law governing such cases, ignored said bill of indictment and has made a return of its action to your honorable court.

Your petitioner further sets forth, that as a further and stronger evidence of the said grand jury's wilful disregard of the law in this case, and its duty in the permises, it imposed upon your petitioner, the prosecutor, a public officer, the burden of defraying all costs and expenses accrued in said legal proceedings.

That your petitioner in instituting these proceedings and in all his subsequent conduct regarding the prosecution of the same, acted conscienciously in the performance of his duty as a public officer, under

the direction of the Dairy and Food Commissioner of the Commonwealth, to whose department of the State government is specially delegated the prosecution of cases involving violations of the aforesaid act of Assembly.

Your petitioner further sets forth, that in line with the policy of the grand jury disclosed in the above case, substantially similar evidence being submitted to it in about 390 other cases upon the same date, the said grand jury ignored the testimony of the witnesses, and failed to find and return to this court, true bills according to law; and furthermore, unlawfully and unjustly placed upon the prosecutor, your petitioner, the burden of paying the costs in said proceedings.

That in addition to the offense of selling a substance colored in violation of law as aforesaid, in many of the above cases the defendant was charged with selling oleomargarine without first having had or obtained a license as is required by the act of Assembly; and others still, with having sold the same and not delivering it to the purchaser in wrappers plainly stamped on the outside thereof with the word "Oleomargarine" or "Butterine," as is required by law.

Wherefore, your petitioner prays that an order may be made by this honorable court, directing that the indictment above referred to be re-submitted to the grand jury aforesaid, which is now in session, and that your honorable court, if it be deemed meet and proper in the premises, instruct the said grand jury regarding its duty in the premises, in order that proper returns may be made and justice be done in this matter; and such other and further relief as the court may deem proper in view of the facts set forth in this petition.

And he will ever pray, etc.,

JAMES TERRY,

Special Agent of the Dairy and Food Division of the Department of Agriculture.

Sworn to and subscribed this 24th day of September, A. D. 1901.

Geo. W. Miller,

Clerk of the Court.

AFFIDAVIT OF GEO. H. WILCOX.

State of Pennsylvania, }
County of Allegheny, } ss:

Personally appeared before me George H. Wilcox, who being duly sworn according to law, deposes and says, that on the 20th day of

September, 1901, he appeared before the grand jury of Allegheny county and in the case of the Commonwealth vs. S. B. Charters, testified substantially as follows: That he was an agent of the Dairy and Food Commissioner of the Commonwealth of Pennsylvania; that on the 1st day of September, 1900, he purchased from S. B. Charters, the defendant, an article or substance which resembled yellow butter; that said purchase was made in the county of Allegheny from the said defendant; that the article so purchased was by this deponent marked upon the wrapper in which the same was delivered by the defendant to the deponent, the date of purchase and the initials of this deponent, and the sum paid by him for said article, together with a number identifying the sample; that deponent delivered the said sample so wrapped and marked as aforesaid, to Prof. F. T. Aschman, in the city of Pittsburg, to be analyzed by the said Aschman, who was then and there a chemist employed by the Dairy and Food Commissioner.

Deponent further states, that he was sworn and examined by and before the said grand jury on the date aforesaid, in regard to a number of other purchases of a like article made by him from various defendants against whom bills had been presented and were then pending before the said grand jury, this deponent testifying in each of said cases to the purchases made by him from the said defendants, respectively, giving in each instance the date of such purchase, and the amount paid, and that he had in each case marked the sample as above indicated, with the date and place of purchase and the name of the defendant, and that he delivered each of said samples to the aforesaid chemist for analysis.

Deponent further states that he has kept the said samples in every instance from the time of the respective purchases thereof until their delivery to the said chemist, in his own possession, and that nothing had been added thereto or taken therefrom, and that the samples in each instance were delivered to said chemist in the same condition which they respectively were at the time of purchase.

GEORGE H. WILCOX,

Special Agent, Dairy and Food Division of the Department of Agriculture.

Sworn to and subscribed before me this 24th day of September A. D. 1901.

Geo. W. Miller,

Clerk of the Court.

AFFIDAVIT OF F. T. ASCHMAN.

State of Pennsylvania, } ss:
County of Allegheny, }

Personally appeared before me, Professor F. T. Aschman, who being duly sworn according to law, deposes and says: That he is a chemist residing in the city of Pittsburg, Pennsylvania, that he is employed by the Dairy and Food Commissioner of Pennsylvania to make analysis of food products, that on the 1st day of September, 1900, deponent received from G. H. Wilcox, who has made and subscribed the foregoing affidavit, the article or substance stated by him to have been purchased on the date aforesaid from S. B. Charters; that deponent analyzed the said substance and found the same to be oleomargarine, colored by the introduction of foreign material in imitation of yellow butter; that deponent appeared before the grand jury of Allegheny county on the 20th day of September, 1901, and produced before the said grand jury the article or substance (in part) so delivered to him as aforesaid by the said Wilcox, and so analyzed and stated to the said grand jury under oath, that he had found the same to be oleomargarine, colored by the introduction of foreign material in imitation of yellow butter; that deponent had, in like manner, received from various other agents, packages containing substances purchased by them from a large number of defendants against whom bills of indictment were then pending before the said grand jury, and that deponent appeared before the said grand jury on the date aforesaid, and testified under oath as to the result of the analysis made by him of the substances so delivered to him by the said agent, stating in each instance that the analysis made by him showed the substance to be oleomargarine, colored by the introduction of foreign material in imitation of yellow butter; that deponent was specific in his testimony as to the substance purchased from each of the defendants against whom the indictments were so pending as aforesaid, and in each instance produced before the said grand jury a complete statement from his books showing the result of the analysis in each case.

F. T. ASCHMAN,

Chemist of the Dairy and Food Division of the Department of Agriculture.

Sworn to and subscribed before me this 24th day of September, A. D. 1901.

Geo. W. Miller,

Clerk of the Court.

TO THE HONORABLE THE JUDGES OF THE COURT OF QUARTER SESSIONS OF ALLEGHENY COUNTY, PENNSYLVANIA.

The petition of Jesse K. Cope respectfully represents that he is the duly appointed Dairy and Food Commissioner of the Commonwealth of Pennsylvania, and that he is charged by the laws of the State with the duty of enforcing the various statutes, relating to the sale and adulteration of food products, and also with the duty of enforcing the law of the State, regulating the sale of oleomargarine, colored in imitation of yellow butter.

That for the purpose of enforcing said laws, your petitioner, the Dairy and Food Commissioner, has appointed various special agents in various parts of the Commonwealth, to ascertain and report alleged violations of the statutes aforesaid.

That in the performance of the official duty thus imposed upon your petitioner, as the Dairy and Food Commissioner of the Commonwealth of Pennsylvania, your petitioner instructed agents employed, as aforesaid, to investigate and report, as to whether illegal sales of oleomargarine were being made in the cities of Pittsburg and Allegheny and elsewhere in the county of Allegheny.

That the said agents made reports to your petitioner, showing that they had purchased various articles believed by them to be colored oleomargarine, from various residents of the cities aforesaid and of the county aforesaid.

That the articles so purchased by said agents were submitted to inspection and analysis by a competent chemist, duly selected and appointed for that purpose.

That the said chemist made report to your petitioner, that the articles so purchased as aforesaid, by the said agents, were in each instance oleomargarine, colored by artificial means in imitation of yellow butter.

That upon the receipt of the report of said chemist upon the various articles so purchased as aforesaid, your petitioner in the performance of his official duty, and for the purpose of enforcing the laws of the Commonwealth against those who had apparently violated the same in the sale of the aforesaid articles, your petitioner instructed James Terry, the Chief Supervisor of the Agents of the Dairy and Food Department at Pittsburg, Pennsylvania, to commence prosecutions against various persons, who had apparently violated the law regulating the sale of oleomargarine, in the manner above stated.

That the said James Terry, in pursuance of said instructions from

your petitioner, commenced various prosecutions to the number of about four hundred against various residents of the county of Allegheny, and that in pursuance of said prosecutions and the return thereof to this honorable court, bills of indictment were duly prepared by the District Attorney of Allegheny county, and submitted to the Grand Inquest of the Commonwealth of Pennsylvania, inquiring in and for the said county of Allegheny.

That before the said Grand Inquest, the said prosecutor called, as your petitioner is informed and believes, the various agents who made purchases of the articles aforesaid from the various persons against whom the said bills of indictment were thus presented, and called also the chemist who had made an analysis of the said articles, as above stated.

That in support of each of the said indictments, as your petitioner is informed and believes, the said Grand Inquest heard the testimony of an agent of the Dairy and Food Department, who had purchased from the defendant named therein, the article charged in each indictment to have been sold by the said defendant.

That the said Grand Inquest further heard the testimony of the chemist, who had analyzed the articles alleged to have been sold in each case, who testified before the said Grand Inquest, that the article so sold by each defendant was oleomargarine, colored in imitation of yellow butter.

That notwithstanding the positive testimony submitted under each of said indictments, showing that each particular defendant had made a sale of an article as ascertained by analysis, as aforesaid, to be oleomargarine colored in imitation of yellow butter, and which, therefore, under the laws of Pennsylvania could not be sold, the said Grand Inquest on the 20th day of September, 1901, ignored all of the said bills of indictment to the number of 394, and directed that the costs of prosecution be paid by James Terry, whose name was endorsed upon each of the said bills as the prosecutor.

That afterwards, to-wit, on the 24th day of September, A. D. 1901, the said James Terry presented his petition to this honorable court, setting forth the fact that he had commenced the several prosecutions, above referred to, as an agent of the Dairy and Food Department of Pennsylvania, and under the instructions of said Department, and that he had caused to be produced before the Grand Inquest aforesaid, the positive testimony of the person making the purchase from each defendant, charged in the said indictments severally with unlawful sale of oleomargarine, and had also caused to be produced before the said Grand Inquest, the testimony of the chemist to the effect that the articles sold by each defendant named in any of the said indictments, was oleomargarine, colored in imita-

tion of yellow butter, and thereupon suggesting to this honorable court, that the said bills had been ignored by the said Grand Inquest without giving proper consideration to the testimony submitted to and heard by the said Grand Inquest, and therefore respectfully requesting this honorable court to return the said indictments to said Grand Inquest or to some subsequent Grand Inquest, in and for the county of Allegheny, with proper instructions to each inquest, as to its duty in the consideration of testimony offered to support the said indictments. That afterwards, to-wit, on the ——day of ———, 1901, this honorable court declined to submit the said indictment, or any of them to the Grand Inquest aforesaid.

Your petitioner now respectfully represents, that the prosecutions, under which the said indictments were presented, were commenced in good faith for the purpose, and under the circumstances hereinbefore fully set forth. That your petitioner had in view at the time he directed the commencement of said prosecution, no other purpose than that of enforcing the law, in accordance with his official duty.

That by reason of the action of the Grand Inquest aforesaid, a large amount of costs, aggregating more than five thousand dollars ($5,000) is about to be demanded from the said James Terry, who began the prosecutions, with the instructions and under the circumstances hereinbefore set forth.

Your petitioner further respectfully represents, that in his opinion, it would be unjust to permit the finding of the said grand jury, with respect to the payment of costs, to be enforced against the said James Terry, or against any person in any way connected with the commencement of the said prosecutions.

Your petitioner further respectfully represents, that he is now, as he always has been, desirous of enforcing the various laws, with the execution of which your petitioner is officially charged by virtue of his office.

That to permit the said finding of the said Grand Inquest, as to the costs to be enforced against the said James Terry, would, as already stated, be, in the opinion of your petitioner, unjust, because he had acted in good faith and in an official capacity, and as your petitioner is advised, is entitled under the law and the practice of the courts of Pennsylvania to be relieved from the payment of costs.

Your petitioner, therefore, respectfully requests this honorable court to make an order, setting aside the finding of the said Grand Inquest, as to the payment of costs in the several prosecutions, commenced as aforesaid, and further respectfully asks permission to renew the application originally made by said James Terry, as prosecutor, for the re-submission of the aforesaid bills of indictment to the Grand Inquest of the county of Allegheny, with proper instructions

from this Honorable Court to the Grand Inquest, as to its duty, in case evidence shall be presented, showing sales of oleomargarine to have been unlawfully made by any of the defendants named in the said indictments.

Your petitioner further respectfully represents, that unless he can, in his official capacity, have from this Honorable Court the aid and relief hereinbefore respectfully requested, that he will be greatly embarrassed in the performance of his official duty, and the Executive Department of the Commonwealth will be hindered and prevented from properly executing and enforcing the laws of the State, regulating to the sale of oleomargarine; and in order that your petitioner and the Executive Department of the State may receive from this Honorable Court that aid and assistance, which your petitioner is advised should be accorded to the Executive Department of the Commonwealth by the several courts of the Commonwealth, your petitioner respectfully submits this petition and earnestly prays that relief be granted, as hereinbefore requested.

Very respectfully,

JESSE K. COPE,
Dairy and Food Commissioner.

Commonwealth vs. S. B. Charters, et al.	}	In the Court of Quarter Sessions of Allegheny County, Pennsylvania, September Session, 1901. No. 641.

Brief of Argument in Support of the Petitions of James Terry, Special Agent, and Jesse K. Cope, Dairy and Food Commissioner, Asking for Re-submission of the Indictments in the Above Cases to the Grand Jury, and for the Striking off of the Order of the Grand Jury, Directing James Terry, as Prosecutor, to Pay Costs.

For the purpose of this discussion, the facts stated in these petitions are to be regarded as true and correct, if so, then each of the indictments presented to the grand jury was supported by such evidence as established clearly a "prima facie" case against each of the defendants for an unlawful sale of oleomargarine.

The purpose of commencing these prosecutions was solely to enforce the law, prohibiting the sale of oleomargarine when colored in imitation of yellow butter.

The prosecutions were commenced by the proper authority of the Executive Department of the Commonwealth of Pennsylvania. A public purpose was intended to be promoted by the commencement of these prosecutions. No private interest was considered in setting the law in operation.

The action of the grand jury has apparently been taken in utter disregard of the testimony submitted. Such action, it is respectfully contended, calls for more than passing notice from this Honorable Court. If the laws of the Commonwealth have been violated, and the evidence submitted to the grand jury clearly indicated such violation, then there has been a manifest disregard of duty by the grand jury, which calls for correction at the hands of this Honorable Court.

This Court is charged with the duty of administering justice and enforcing obedience to the mandates of the statutes of the Commonwealth. To permit a clearly proven violation of the law to go unrebuked and unpunished, would be discreditable to the administration of justice. If the Executive Department of the Commonwealth is expected, as it certainly is, to enforce the law in accordance with the mandate of the statutes of the Commonwealth, it must look to the courts for aid and assistance in bringing offenders to trial.

If it be suggested that the action of the grand jury is not final, and that new prosecutions may be commenced against the alleged offenders, it is respectfully submitted that a sufficient reply to this suggestion is the fact that costs have already been incurred to a large amount, in a faithful effort on the part of the representatives of the Commonwealth to bring alleged offenders to justice, and that these costs ought not to be borne by any public official, or by any municipal division of the Commonwealth. If the law has been violated, the costs of punishing the offenders should, as a matter of simple justice, be imposed only upon such offenders. To permit these costs to be borne by a public official, who has acted in good faith in the performance of official duty, would be contrary to justice, and in violation of all judicial precedent. To permit these costs to be paid either by a county or by the Commonwealth itself, would be to encourage offenders to continue their disregard of the mandates of the Commonwealth. It would invite disregard of law and continued violations. The law in question was duly enacted by the Legislative Department of the State Government, after full discussion and consideration of the merits of the measure.

It is too late to consider whether the statute is wise or unwise. It is the law of the Commonwealth, and as such must be enforced by

the Executive Department of the State, and obeyed by the citizens of the Commonwealth.

This Honorable Court is respectfully and earnestly requested to consider the grave situation created by the action of the grand jury. This action seems to indicate that the grand inquest, moved by an unfavorable opinion as to the wisdom of the law, has chosen to disregard a statute of the State. Such disregard, we respectfully submit, calls for judicial action, in order that the law may be maintained and obedience to legal procedure properly enforced.

That this Honorable Court has the power to direct a re-submission of these bills to a grand jury, with proper instructions as to the duties of the grand inquest, cannot be doubted.

If it be suggested that the number of indictments presented is excessive and indicates a disposition to persecute rather than prosecute, the answer is that where more than one indictment has been presented against a single defendant, that defendant has had a license for several different places of business, and at each of said places of business, has, upon more than one occasion, violated the law by making sale of a prohibited article. Even if more indictments had been presented against a single defendant than was proper under all the circumstances, this would be no good reason for allowing such defendant, if violation of law was established by evidence, to go unindicted and unpunished.

This Honorable Court has ample power to control the prosecution of indictments, and if more indictments were returned against a single person than in the opinion of the court should have been presented, the Court, from its inherent power to administer justice, could control the prosecution of said indictments and the punishment thereunder.

If upon an examination of all the indictments, which have apparently been improperly ignored by the grand jury, this Honorable Court shall be of the opinion that an unnecessary number of indictments have been presented against any single individual, it can now direct that only such number of indictments against any single person shall be re-submitted to the grand jury, as in the opinion of the court shall be proper and right.

In regard to the payment of costs, as directed by the grand jury, it is respectfully submitted that the direction of the grand inquest upon this subject is manifestly unjust. That this Court, by virtue of its inherent power to administer justice, has control over the subject of costs, cannot be doubted, and the courts of the Commonwealth have universally refused to require payment of costs by a public official, acting as a prosecutor in his official capacity, unless it were clearly shown that the official had acted in bad faith and in disregard of his

duty. It is therefore respectfully submitted, that in these cases the prosecutor, as a public official, has proceeded in good faith and solely for the purpose of performing official duty, and is entitled to the protection of the Court.

Guffey vs. The Commonwealth 2nd Grant 66, Mr. Justice Lewis, delivering the opinion of the court in this case says, pages 68-69: "The jury have the power to name the prosecutor, but if they name one against whom there is not a particle of evidence, one who was not the prosecutor and who had no notice whatever of the proceedings, the injustice would be so monstrous that it seems impossible to doubt in regard to the power and duty of the court to grant redress. So if the jury should name as prosecutor the justice who issued the warrant, the constable who executed it, or the district attorney who sent up the indictment and prosecuted it, without any other evidence against them, except proof of the performance of their official duties, the demand for a prompt and efficient remedy would be equally imperative. No man can suppose for a moment, that the Legislature intended to place it in the power of the jury to impose severe penalties upon public officers for the faithful performance of their duties—where the prosecution is not trifling, but one of a grave character, where it is not unfounded but founded upon probable cause existing at the time it was commenced—and where there is no evidence of malice in the prosecution, it is the duty of the court to set aside the verdict against the prosecutor for the costs. In short, this is the duty of the court in all cases where there is nothing in the testimony to show that the prosecutor behaved improperly."

This decision of the Supreme Court of Pennsylvania stands unreversed and unchallenged. It has been frequently followed by the lower courts.

Commonwealth vs. Ream 1st County Court Reports 33.

In this case the court of quarter sessions in Lancaster county set aside the verdict of a jury imposing costs upon a constable, who was the prosecutor. On page 35, Judge Wickes, delivering the opinion of the court says "it must be borne in mind that these are not cases in which the officers returned within their knowledge, places kept in violation of the law. In that event they would be the real prosecutors, and for their honest mistakes it would be manifestly proper the county should pay, because the policy of the law would not allow an officer to be thus embarrassed in the discharge of his official duties."

Commonwealth vs. Grimm 1st County Court Reports 40.

In this case, the quarter sessions of Northampton county relieved the prosecutor upon whom costs had been placed by the grand jury,

because he was an officer of the Society for the Prevention of Cruelty to Animals, Schuyler, P. J., delivering the opinion of the courts, says: "The grand jury ignored the bill and imposed the costs on the prosecutor. The agents of the S. P. C. A., are regarded as peace officers, and as such are entitled to the protection of the Court."

That the Court possesses the power to control the findings of a grand jury as to costs, is abundantly shown by numerous authorities, among which are the following:

Commonwealth vs. Bain, 1st County Court Reports 25.

Connoly vs. Lackawanna County, 1st County Court Reports 26.

Commonwealth vs. Jackson 1st County Court Reports 38.

Other authorities might be cited, but it is respectfully submitted that even these are not needed to satisfy this Court of its inherent power to control the finding of the grand jury as to costs in these cases.

These prosecutions were commenced by a public official in the performance of his official duty. He proceeded by the direction of his superior officer, connected with the Executive Department of the Commonwealth. That he is entitled to the protection which this honorable court has the power to grant, we respectfully contend, and we respectfully ask the court to relieve him from the payment of any costs whatsoever.

In order that no injustice may be done to anyone entitled to costs, it is respectfully suggested that this honorable court direct the re-submission to the grand jury of the indictments in these cases or of such number of them as the court may deem proper to re-submit.

If true bills are returned, as we respectfully submit the evidence requires, and the defendants are brought to trial and convicted, this court has ample power to make such order, in regard to the prosecution of more than one indictment against a single defendant, and in regard to the payment of costs upon the other indictments, as will be just and proper. If the law has been violated repeatedly by any defendant, then it would be manifestly proper, in case of his conviction upon one indictment, to direct the payment of costs upon the other indictments, and permit a *nolle prosqui* to be entered on the other indictments upon the payment of costs. In this way the costs could be imposed upon those, who, after a hearing, have been shown by the evidence, to have violated the law, and he, who has acted only in his official capacity and solely for the purpose of performing his official duty, would be relieved from the injustice sought to be inflicted upon him by the grand jury.

If this court shall desire to make inquiry into the facts, or if the facts are stated in the petitions now before this honorable court are challenged, we respectfully ask that rules be granted to show cause why the indictments should not be re-submitted, and why the

prosecutor should not be relieved from payment of costs, so that after full hearing of testimony by depositions or otherwise, and full argument upon the questions raised by such rules the court can take such action as may appear to be proper and necessary in the due administration of justice, and the enforcement of the laws of the Commonwealth.

To permit violations of the law to go unrebuked and the violators to escape under the protection of a grand jury, which has apparently disregarded proper evidence, would, it is respectfully submitted, be a menace to government, and an invitation to offenders to violate the law.

Respectfully submitted,

SAMUEL J. M. McCARRELL,

Attorney for Dairy and Food Division, Dept. of Agriculture.

REPORT OF THE STATE VETERINARIAN.

Harrisburg, January 1, 1902.

Hon. John Hamilton, *Secretary of Agriculture:*

Sir: It is with pleasure that I furnish you the following review of the work that has come to me as State Veterinarian and as Secretary of the State Live Stock Sanitary Board for the calendar year terminating December 31, 1901.

The year has been one of great activity and progress in respect to the development of knowledge of the diseases of animals and to its practical application. There has also been a marked and gratifying increase in interest in suppressing the diseases of animals, due, in part, to a fuller realization of the losses that come from such diseases, and in part, to the evidence that a successful warfare may be urged against them.

In the subject of tuberculosis, this increase in interest has been very great. A cause that helped to bring this about was the British Congress for the study of tuberculosis, held in London last July. At this congress experts gathered from all parts of the world to discuss this most widespread and destructive of all diseases. The current knowledge of the subject was well reviewed and summarized and several notable contributions to the pre-existing fund of information were offered.

If not the most important at least the most sensational paper presented at the London Congress was that of Dr. Robert Koch, of Berlin. In this paper Dr. Koch cited certain experiments he had made in co-operation with Dr. Schuetz, wherein he had attempted to produce tuberculosis in cattle and other animals by inoculation and feeding with sputum from consumptives. These experiments indicated to him that tubercular sputum from persons is not especially virulent for animals of some species and notably for calves. From this observation he drew the deduction that animal and bovine tuberculosis are not the same disease nor so closely related as to be intercommunicable. This dogma was opposed in the congress by Nocard of France, by Bang of Denmark, by Lister and McFadyean of England, by Thomassen of Holland and by Ravenel of Pennsylvania. Before the close of the congress a resolution was adopted in which was recommended the continuation of all efforts to protect the public

from the products of tubercular cattle, and it was also recommended that investigations should be instituted to further test the point raised by Dr. Koch.

It is interesting to note that Koch was not the first to make the observations that he reported, if he was the first to construe them as he did. Similar observations were made in America four years ago by Smith, Frothingham and Dinwiddie. In order to more closely examine this subject, to compare the virulence of bovine and human tubercle bacilli and to measure, so far as possible, the capacity of bovine tubercle bacilli to produce disease in animals other than cattle, an extensive series of experiments was instituted at the laboratory of the State Live Stock Sanitary Board in 1898. These experiments were reported by Dr. Ravenel at the London Congress, and his report upon them is published, together with his report on the congress, in another part of this volume.

These experiments are confirmed by those of Koch and Schuetz, but they do not confirm Koch's deductions. On the contrary, they appear to show that Koch's deductions are illogical and unsound. They show, beyond peradventure, that bovine tubercle bacilli are for most animals more virulent and in all cases, so far as tested, quite as virulent as tubercle bacilli from man. Hence, instead of indicating that bovine tubercle bacilli are not a probable source of tuberculosis in man, these experiments furnish cause to fear, if not to believe, that tubercle bacilli from cattle are at least as virulent and deadly for persons than are those from other human beings. Other experiments and observations have been made that tend to show the great care that should be exercised in the use as food of the products of some tubercular cattle, and these will soon be reported.

It is important to observe that Koch's deductions have not been drawn, nor is his opinion held, by any other research worker in the field of sanitary science. Moreover, Koch's dogma is not allowed in any country of Europe to limit the work of the suppression of tuberculosis of cattle nor to interfere with the inspection of milk or of meat.

The result of this whole discussion will be to stimulate observations and experiments that will soon settle the case in some way so that the subject will be removed from the field of controversy to establish fact, and opinion in regard to it will crystallize. To contribute to the solution of this important question is a duty and a privilege, and there is reason for pride in the knowledge that the State Live Stock Sanitary Board of Pennsylvania is doing its share.

It seems pertinent at this time to consider an opinion that was offered during the summer, when there was so much discussion of Koch's alleged discovery, namely, that if it should develop that tuberculosis is not transmissible from cattle to man, there will be

no further need of efforts to repress this disease in herds. Such opinions are offered by men who have no knowledge or appreciation of the extent to which cattle owners are injured by tuberculosis among their animals. There is no disease of cattle that causes so much loss as tuberculosis. This is true not only in Pennsylvania but, we have the words of Bang and Nocard for it, it is true also in the older parts of the world, where such malignant and rapid diseases as rinderpest, pleuro-pneumonia and foot and mouth diseases prevail. The losses from this disease are great enough to justify much greater effort and expense than are now authorized. If the fight against tuberculosis of cattle were to stop because one bacteriologist claims that the disease is not transmissible to man, then there is no ground for public measures to suppress contagious pleuro-pneumonia of cattle, Texas fever, hog cholera, contagious abortion, or the San Jose scale.

The duty to repress the contagious diseases of animals is recognized as a public duty in every civilized country of the world, and in every State in the United States, and for the reason that it is essential to the welfare of the public that such diseases shall be suppressed and it is impossible for the individual to do it.

I wish to record the fact that since the general discussion of Koch's dogma, the number of voluntary applications for herd tests has not fallen. There is as much desire now for herd tests as before. This appears to indicate that Koch's views have failed to find acceptance among cattle owners or that their purpose in eradicating tuberculosis is economic rather than for the protection of the health of the people.

In relation to glanders, the contest this year has been a little more strenuous. Twenty-one glandered horses and mules have been found and destroyed. In nearly all cases these were animals that had been recently brought into the State or had been infected by such animals.

The work of the laboratory during the year has been most valuable. The accurate, scientific control of the general field work that this agency has rendered possible has been of incalculable benefit. Questions of diagnosis in respect to animals that are dead can sometimes be solved only by the aid of the bacteriologist and pathologist; that is, by the aid of a properly manned and equipped laboratory. To leave such questions without full solution, would mean, in some cases, the loss of information that would make it possible to prevent similar disease in the future or, in other cases, the taking of more or less burdensome and expensive precautions that are unnecessary.

For example, by ordinary method of post mortem examination, it may not be possible to determine whether a given animal has died of anthrax. If, on account of this lack of information, no special precautions shall be taken with an anthrax carcass this disease may

become established in a new locality and greatly interfere with stock raising and injure the value of farms in a considerable district. If, on the other hand, it can be shown that a supposed outbreak of anthrax is, in reality, some less dangerous disease, special precaution and alarm are avoided. It has, in fact, happened that by the discovery of the first case of anthrax in a neighborhood the permanent establishment of the disease has been avoided.

The early diagnosis of rabies, which is possible only by the use of exact laboratory methods, is of such extreme importance that it is realized as soon as attention is called to it. If a person is bitten by a dog that is suspected of being rabid, nothing is of greater importance to that person than to know whether the dog was rabid or not. About one hundred diagnoses of rabies by the use of the new rapid histological method of Van Gehucten and Nelis have been made in the laboratory of the State Live Stock Sanitary Board by Dr. Ravenel, who was the first to introduce this method of diognosis in the United States.

By means of bacteriological examinations of cadavers and specimens it has been discovered that certain wide-spread diseases of hogs supposed to have been cholera were in reality another disease.

Diagnosis of glanders, tuberculosis and many parasitic diseases have also been made in the laboratory and many specimens have been submitted for examination and reported by veterinarians and stockowners in all parts of the State. The laboratory of the State Live Stock Sanitary Board is the only one in the State that is prepared to do this sort of work.

About 55,000 doses of tuberculin were made during the year, and all of the mallein and anthrax vaccine used in the work of the State Live Stock Sanitary Board. Besides the work referred to above, a number of investigations have been conducted for the purpose of increasing the fund of existing knowledge in relation to several of the diseases of animals. The research work that has been done on tuberculosis is discussed in another part of this volume, and will soon be reported upon in greater detail. Other diseases studied are rabies, paralysis of hogs, lung worm diseases, dysentery of cows, mountain disease of cattle and forage poisoning of horses. This work of the laboratory is supported by a special appropriation of $5,000.00 a year.

In relation to the general field work of the State Live Stock Sanitary Board, I shall report on the following subjects separately:

RABIES.

During the year, rabies has prevailed to an alarming degree. Nearly all parts of the State have been visited by rabid animals and much loss has come from bites inflicted by them. Four apparently

well authenticated cases of deaths of people from rabies have been reported and the following numbers of animals are known to have died of this disease; 5 horses, 68 cattle, 24 sheep, 27 hogs and 146 dogs. There is no doubt that there were many more deaths not reported, and some reports not confirmed are not included in the above list. Fifty-six diagnosis of rabies in animals (horses, cattle and dogs) have been positively established in the laboratory of the State Live Stock Sanitary Board. The rapid method of diagnosis has been studied and tried thoroughly by Dr. Ravenel, and its great value is now established. The particular value of this method is that it enables one to ascertain within three or four days whether a suspected dog was actually rabid. This is most important when a person has been bitten. If it is found that the dog was not rabid, needless alarm is avoided, while if it is shown that the animal was rabid there is ample time to employ the Pasteur protective treatment.

The plan has been continued this year of quarantining the dogs that have been exposed or, in restricted areas, that may have been exposed to the bite of a rabid dog. This has been the means of confining dogs that have subsequently developed rabies. Under these conditions such dogs could be destroyed before they had a chance to spread disease. But the disease is so very wide spread that even when it is repressed in a given locality there is constant danger of its introduction from without, so that unremitting watchfulness must be maintained.

The last Legislature enacted the following law which was approved by the Governor April 11th, 1901:

"A supplement to an act, entitled 'An act for the taxation of dogs and the protection of sheep,' approved the twenty-fifth day of May, Anno Domini one thousand eight hundred and ninety-three, providing that the fund raised by the taxation of dogs be applied in addition to the loss of sheep, for the loss of other domestic animals bitten by mad dogs.

"Section 1. Be it enacted, &c., That the fund raised by the taxation of dogs, as provided by the act of the General Assembly, entitled 'An act for the taxation of dogs and the protection of sheep,' approved the twenty-fifth day of May, Anno Domini one thousand eight hundred and ninety-three, in addition to the application thereof for the payment of losses sustained by the destruction and damage to sheep, be applied for the payment of horses, mules, cattle and swine bitten by a mad dog or mad dogs, and destroyed or necessary to be destroyed by reason thereof. Said damages shall be ascertained and recovered in the same manner as provided by section three, four and five of the said act: Provided, That in no case shall the value of each horse or mule exceed one hundred dollars, the value of each head of cattle forty dollars, and each head of swine six dollars.

"Section 2. All acts or supplements of acts inconsistent with the provisions of this supplement are hereby repealed: Provided, That this supplement shall not repeal or affect the provisions of any special law relating to the same subject in any county, township, borough or city in this Commonwealth."

This law makes it possible for the owners of animals dying of rabies to receive remuneration from the dog tax fund. I anticipate that the effect of this law will be beneficial, in that it will make a charge on the counties in which rabies prevails and will tend to increase local interest in repressing the disease.

There has been and is yet in some places the utmost apathy in regard to the repression of this very dangerous disease. It seems safe to trace much of this apathy to the wide spread opinion that rabies does not exist—that there is no such disease. This most astonishing mental attitude results only from wilful ignorance—from closing the eyes to the clearest evidence.

Rabies is as distinct a disease as anthrax, tuberculosis or small-pox. The foolish and harmful views that have been circulated on this subject have had the effect of greatly favoring the spread of the disease. When people are encouraged to believe that a thing is mythical, they cease to work against it. But the large number of deaths from rabies and the increasing distribution of this disease should arouse the public to a realization of the need of actively supporting measures directed against it.

In a previous report I have taken occasion to cite the experience of England in dealing with rabies. It is interesting to note that this disease has been entirely exterminated from England, Scotland and Wales, not a single case appearing last year. This shows what it is possible to do by appropriate measures, thoroughly enforced. The system so successfully employed consisted in the quarantining of all dogs, under which they were required to wear muzzles and to be kept on a leash, and the prohibition of the importation of dogs. Of course this plan in its entirety is impossible in Pennsylvania, because dogs can not be kept from entering from other States. But by muzzling dogs in all localities where rabies is know to exist (and by confining them as well) for 100 days after the appearance of the last case of disease, much can be done to keep it in check. If rabies can not be exterminated, there is every reason to expect that it can at least be kept within such bounds that it will be the source of much less danger.

If there were ten times as much rabies as there is, there would, probably, be less difficulty in enforcing the simple and unoppressive measures adopted by the State Live Stock Sanitary Board. But so long as only four people and 270 animals are dying of rabies each year, the need for muzzling dogs at certain times seems to some people to

be trifling as compared with the temporary inconvenience of their pets. Hence much difficulty is experienced in enforcing the quarantine of dogs during outbreaks of rabies.

TUBERCULOSIS.

As is stated above, voluntary applications for tests of herds have not diminished as a result of the discussion of Koch's remarkable, and it is believed unsound, dogma. On the contrary, more herd tests have been asked for this year than ever before. Since the funds available for the work of the State Live Stock Sanitary Board have not been increased, it results that it has been possible to comply with a smaller percentage of the requests for herd inspections this year than hertofore, although the actual volume of work done has remained as before. Since voluntary applications for herd tests have increased so largely it has been possible to sort the applications still more rigidly than heretofore and make the tests in the herds most extensively infected. At present, no herd is tested at State expense unless it is known before hand that it is contaminated by tuberculosis. If there is any doubt on this point, the owner is advised to have a test made at his own expense. This arrangement is made necessary by the fact that there are so many applications on file for the inspection of herds that are positively known to be tubercular that it is not considered fair to use any part of the limited amount available for work on herds that may be sound. While it is not possible, on account of the scarcity of funds, to make complete tuberculin tests of all herds covered by owners' applications, it is possible to make physical examinations of all herds in which there is reasonable ground to fear the existence of tuberculosis. By this physical examination, the more advanced and most immediately dangerous cases can be discovered and removed, bad sanitary conditions can be corrected and thus, although the disease is not eradicated in such a herd, an appreciable start is made toward repressing it.

There is still much damage done by the sale of tubercular herds. When it becomes evident, through the death or debility of some of its members, that a herd is tubercular, some owners submit to the strong temptation to sell their cattle. They reason that, by so doing, they are violating no special law, that they will receive more for their possibly diseased, but still healthy looking, cows than the State will pay, and they are escaping further loss. Of course there are manifest drawbacks to conducting this sort of business in the locality in which one lives. So such cows are usually sold to a dealer and are removed by him to some distant place, perhaps to another State. I believe that this sort of traffic should be discouraged by special legislation and by providing a safe market for tubercular cows. By a safe mar-

ket, I mean such an outlet for them as exists in Switzerland, for example. In that country, cows found upon tuberculin test to be tubercular are not destroyed if they are still in the earlier stages of disease, but they are marked by cutting a piece out of the ear in a characteristic way, so that every one may know that the cow is tubercular. Then the sale of cows so marked is not prohibited but, by the obvious mark that is everywhere understood, every one is warned that this cow must, for the safety of the owner and his herd, be kept in such a way that disease can not spread from her. This is easily accomplished by keeping the cow in a stable apart from healthy cattle, by having her pastured apart from them and by heating her milk to 165 degrees F. for ten minutes. Some of these tubercular cows when kept under these conditions continue to render useful service for two, three or even for four years. Cows that would be a source of great danger and loss in a herd may be kept in this way with profit. Their calves are almost always born healthy and may be reared in health if they are removed soon after birth and are kept away from tubercular cows, and are fed on the heated milk of such cows or on the milk of healthy cows. If herds of cows in the earlier stages of tuberculosis were established, but only under inspection and quarantine, their milk could, with proper precautions, be used for many purposes and such herd would furnish a safe outlet for the reacting cows from other herds.

I do not advance this plan as a recommendation but as an idea worthy of consideration. In order that the spread of tuberculosis may be checked,it is necessary to prevent the scattering of tubercular cows among healthy herds. So long as there is not sufficient public money available to buy all tubercular cows, it may be worth while to provide a market for them so that their owners can get rid of them without too much loss and in a way that does not jeopardize the health of the herds they go into.

The law governing the inspection of cattle coming into the State has worked well and smoothly during the past year. An agent has been continuously employed to control shipments of cattle into the State and to see that they are inspected as the law requires. His services have been effective in securing a strict observance of the law. The dealers are now interested in its enforcement and render valuable assistance to this end.

During the year about 17,000 cattle have been inspected and of these, 812 were found to be tubercular and were destroyed. The tubercular cattle were in 467 herds, comprising 5,541 members, all of which were tested with tuberculin.

As a further review of this subject, I beg to submit the following paper on The Control of Tuberculosis of Cattle, read by me before the

Inter-State Association of State Live Stock Sanitary Boards, at Buffalo, October 8th, 1901:

"When a scientific or an economic question is at issue it can be settled so that it will stay settled only by careful, painstaking study of the facts and by their truthful presentation. What this person or that person supposes or guesses or thinks, or what the prejudiced, bombastic, self-advertising speaker or writer may say, contributes nothing to the solution. Facts are what are wanted, not theories; knowledge is what is needed, not empty belief. Moreover, it is well to apply to the study of controversial questions the logical and orderly method that is applied to the solution of a scientific problem, and not depend upon a helter-skelter accumulation of disordered evidence and rush at any cost to what is believed to be a popular verdict, after the manner of the yellow press.

"All of this is patent, but unfortunately, it appears to have been lost sight of in certain quarters in connection with the discussion of tuberculosis of cattle. The atmosphere has been so filled with the smoke of controversy that in order to present the case clearly it appears to be necessary to go back to the elements of the subject and endeavor in an unbiased way to gain from first sources our own information upon which to base our opinions.

"Let us consider some actual occurrences. Truth is sometimes stronger than fiction, and facts may be more startling, and are always more impressive, than theories.

"(1) A farmer in Delaware county, Pennsylvania, had a herd of native cows that had belonged to his father, and wishing to improve them, purchased two pure bred cows and a bull at a public sale. In time, these cattle sickened and after a lingering illness characterized by wasting, they died, but not until some of their progeny had been added to the herd. The breeding of the new strain and its fusion with the old herd continued and, from time to time, a bull or a cow of the adopted breed was purchased. But every winter, in spite of good feed and care, a few of the cattle became poor and after a variable time would die of a disease that was finally recognized as tuberculosis.

"Every effort was made to check the spread of the disease by increased food, by out-door life, by stable care and by medical treatment, but without avail. One winter 6 cows died in the herd of thirty. Eventually the whole herd perished of tuberculosis. A rare case, some one may say. Yes, a rare case, because it is not customary for cows to be held after it is known or feared that they have tuberculosis; they are usually sold to the bologna butcher.

"(2) The owners of a famous dairy herd of pure bred cattle in a neighboring State once consulted me in regard to tuberculosis in their herd. They were constantly losing good cows, and could never feel

reasonably sure that a promising heifer would live to reach maturity and by her performance testify to their skill as breeders. It was very discouraging, and it was unpleasant when their customers reported, after a few months or years, that the animal purchased has died of tuberculosis and that the disease had afterwards appeared elsewhere in the herd. Advice was given as to the plan that might be followed to repress the disease, but probably it was too formidable an undertaking, for I was not again consulted and a short time afterwards the entire herd was advertised as free from tuberculosis and was sold.

"(3) Some years ago two car loads of cows from New York State were sold at public sale in one of the counties of western Pennsylvania. These cows are believed to have come from one herd. Within a few months many of them died of tuberculosis, and within a few years all had perished of tuberculosis or had been killed or sold on account of the existence or fear of this disease. The veterinarian in this district, a very cautious and skillful man, has told me that he never knew of any tuberculosis among cattle there before the arrival of these particular cows from New York, and that afterwards the disease spread largely in and from the herds of which these cows were members.

"(4) A herd of cattle famous in Pennsylvania a decade and a half ago was known to be badly infected with tuberculosis. Many of the most valuable cows died, the younger cattle were unthrifty, development was too uncertain and the owner became dissatisfied. The herd was disposed of at public sale. Tuberculosis in eleven herds has been traced to cattle distributed by this sale. The following may be cited as an illustration: A farmer in an interior county of Pennsylvania had been breeding cattle for about a quarter of a century and had never had any disease among his cattle other than the simple ailments and accidents that occur as a matter of course. One cow was purchased at the sale just mentioned. This cow did well the first season, but afterwards ran down in condition, and after a long illness she died. Later, other cows were lost in a similar way, and when the herd was tested, it was found to be extensively infected. Many other herds in the locality were tested, but no more tuberculosis was found, except in one herd that contained a cow from the infected herd.

"(5) About ten years ago, I was requested to apply the tuberculin test to a herd in which many cows had died of tuberculosis. I reported that a large proportion of the cattle were infected. Nothing more was heard by me from the owner; but subsequently I learned that the entire herd had been sold to a dealer who took it to Kentucky.

"(6) Recently, in Pennsylvania, a herd of sixty-five cattle was

tested with the result that sixty were found to be tubercular. There was absolutely no reason to suspect that anything ailed this herd until after the introduction of a young bull from a New York State herd in which there is considerable tuberculosis. This bull died when he was three years old, of a lingering, wasting disease that was accompanied by coughing. The deaths from tuberculosis in this herd have not been numerous, and probably for the reason that the owner makes a business of selling cows, marketing each one as soon as possible after she is developed. But there is reason to pity their purchasers.

"I shall not occupy your time by citing more illustrations of the ways by which tuberculosis is spread nor of the losses to cattle owners. It would be easy to fill a long paper with accounts of instances wherein tuberculosis has ruined herds and their owners, or wherein, to avoid ruin, men have sold infected herds and have scattered disease and ruin widely.

"In this country, there is less tuberculosis than abroad, because the country is younger and the disease has not had time to spread—to soak into the vitals of the cattle industry. In the older parts of the United States, there are localities where the prevalence of tuberculosis approaches the prevalence in the badly infected countries abroad. There are herds in this country that are infected to the extent of 100 per cent. of their members, and it could be no worse than that anywhere. This degree of infection has been found in isolated instances in every Eastern State. So it is evident that conditions exist in some parts of the United States that are decidedly favorable to the progress of tuberculosis.

"The slaughter house statistics of European countries show the frequency of tuberculosis among the animals killed for food. In Holland, about 13 per cent. are tubercular; in Prussia, 15 per cent; in Saxony, 30 per cent.; and in some slaughter houses one-half of all cattle killed are tubercular. In England, McFaydean says 30 per cent. of the cows are tubercular. Of course, these are not American statistics but they show to what extent the disease will spread under certain conditions. We have the words of Professor Nocard, the greatest French authority, and of Professor Bang, of Denmark, for it that tuberculosis causes far more loss than cattle plague, foot and mouth disease, anthrax and pleuro pneumonia combined. Moreover, serious losses from tuberculosis of swine result from feeding skim milk and buttermilk from tubercular herds.

"Some of the supernatural individuals who write for papers, are in the habit of lightly throwing aside European experience as though it were of no consequence to us. On this point President Charles W. Eliot, of Harvard Universtiy, has said: "It is a disgrace to organized education that any nation should refuse, as our own people are so apt

to do, to learn from the experience of other nations; the schools must have failed to teach history as they should have done. As Benjamin Franklin says: 'Experience keeps a dear school; but fools will learn in no other, and scarce in that.' "

"The nations of Europe have made the mistake of doing nothing to repress tuberculosis until it has gained a vast distribution and is causing frightful losses. Now the problem is staggering in its immensity. The task of repression would have been easy a generation ago—now it is great enough to embarrass the strongest government. It is eating into the cattle industry of Germany as a cancer, it is distressing live stock owners and may be classed as an important cause of agricultural depression. Renneberger estimated that the losses from tuberculosis of cattle amount in Germany to 80,050,000 marks a year, and Wilson estimates the English losses at 3,000,000 pounds sterling a year. And this is the disease that certain writers state is of no importance and requires no special attention! Such persons attempt to deny facts that are as plain as any in history.

"Why should we not learn by observing the errors and misfortunes of our fellow nations? If the wagon in front of yours becomes stalled in the mud, why not avoid the hole instead of finding out by bitter experience that it is quite as difficult and deep for your own wagon?

"Tuberculosis has a good start among the cattle of many parts of this country. If one fact is clear in regard to this disease it is that its tendency is to spread, and it has spread and is spreading in every part of the world contaminated by it, including our own, with the exception of a few localities where active repressive measures are in operation. But, some say, this is due to the "artificial" way in which cattle are kept or to bad stables. This opinion again shows lack of knowledge of facts in relation to the clear history of this disease. It is reported on the best authority that tuberculosis is becoming more prevalent among the cattle always out of doors in the generally healthy climates of New Zealand, Queensland and the Argentine Republic. Unquestionable instances have been recorded wherein tuberculosis has gained extensive prevalence in unstabled herds in Iowa, Montana and British Columbia.

"In order to test this question and to ascertain the influence of ordinary and the best stabling conditions on the spread of tuberculosis in two infected herds, and to determine whether any stabling conditions, accompanied by the most scrupulous care, could be depended upon to prevent the spread of tuberculosis among cattle, the following experiment was conducted under the auspices of the Pennsylvania State Live Stock Sanitary Board.

"Two stables were erected, each containing six stalls. One stable was large, light, well ventilated, and so constructed that it could be kept scrupulously clean. The floor and mangers were of cement,

the walls had a smooth coating of cement, the ceiling was plastered and painted. Between the cows there were stall partitions made of matched, dressed lumber and painted. These partitions kept the cows and their feeding places entirely apart. There was no contact between the animals. The stall partitions and all of the wood work within reach of the cows were washed with an antiseptic solution every day. The cows were watered from separate buckets. The other stable was built in the ordinary way. It was lighted by one window and no special arrangement was made for its ventilation. The floor was of hard clay. The cows were held by stanchions and were fed from a feeding floor extending in front of the entire row of stalls.

"In each stable were placed four healthy and two tubercular cows. The tubercular cows were interchanged from stable to stable every ten days in order to equalize the exposure.

"The experiment continued 17 months and at its close, it was found by testing the cows with tuberculin and also by post-mortem examinations that all of original healthy cows in the ordinary stable had contracted tuberculosis and two, or one-half, of the originally healthy cows in the model stable had contracted tuberculosis.

"This experiment tends to show that the conditions which cattle are kept have a decided influence on the spread of tuberculosis. But the experiment shows very clearly that where the stable conditions are very much better than are practicable on any farm, the spread of tuberculosis cannot be wholly prevented, so long as tubercular and healthy cows are permitted to occupy the same stable.

"Now, if we conclude, as we must, that tuberculosis of cattle is a serious disease, that it is causing burdensome losses, that it is spreading where effective measures are not enforced against it, that it is not due to local stabling conditions and that its progress in other countries and in certain places in this country justify the expectation that its ravages will become greater and more burdensome each year, it follows that something should be done to lessen the present and to ward off the approaching calamity.

"When we come to the consideraiton of the measures that should be adopted, we again enter a field of controversy. All sorts of plans have been proposed, all sorts have their advocates, but only one class of procedures have been found in practice to be effective. So long as tuberculosis was regarded as due to breeding or heredity it was not repressed. Many herds have been bred down from pure blood to mongrel, as by crossing Jersey cows with Ayshire, Simmenthal or Normandy bulls, in the unrealized hope that in this way tuberculosis might be bred out. Many expensive and beautifully constructed stables have been erected for tubercular herds, in the unrealized hope that by improving the sanitary conditions the disease might be

driven away. Many tubercular herds have been forced to rough it in airy barns, in open sheds or even in the unprotected field in the barren hope that such treatment might harden them to withstand the attacks of the tubercle bacillus. These attemps have been made for years; they have not succeeded.

"Tuberculosis has, however, been eradicated from thousands of herds by the application of measures that logically follow the acceptance of the absolutely proven and all-important fact that tuberculosis is a contagious disease.

"Since tuberculosis is a contagious disease and is propagated by contact of tubercular with healthy cattle, and by the products and places contaminated by tubercular cattle the way to eradicate this disease is clear. Remove healthy cattle from contact with those that are tubercular and with their quarters, heat the milk of cows in the visible stages of tuberculosis, prevent the sale and distribution of cows suffering with tuberculosis, and the thing is done.

"The principle is simple, easy to grasp and is promising. Fortunately we do not have to theorize as to its value. It has been put into practical operation on an enormous scale in many parts of the world, and has been the means of actually repressing this disease. The first thing is to show cattle owners the facts, to teach them what tuberculosis is, what it has done, what it will do if unrestrained, how it spreads and the measures that are effective against it. I know that farmers are, as a rule, very anxious to rid their herds of tuberculosis just as soon as they know that the disease is present, and know what it is and what it means to them. But the procedure is expensive and unless the State will bear a part of the burden it is too much to expect farmers to sacrifice their cattle, their sole income producing property, in many instances, for the good of the public. So a common and perhaps natural thing to do is to sell all suspicious animals, and by preference to a dealer who will take them away out of the neighborhood and, if possible, to another State. In this way the individual avoids loss from the death of cattle on his hands, but by so doing he scatters the disease. This danger is increasing, and from the fact that breeders are becoming better able to recognize tubercular cattle and are more anxious to get rid of them. Hence, cattle buyers are each year exposed to more risks unless they know the origin of the cattle they buy or know that they have been properly inspected.

"Some States are expending great effort and large appropriations in a successful effort to eradicate tuberculosis. These States cannot be expected to permit other States not so careful to ship their tubercular cattle to them without restriction.

"This is a very great and pressing danger and is of especial importance to the States of the east—the States that import the lar-

gest number of dairy cows. For the cattle raising and exporting States the subject is not so vital. The New England States, New York, Pennsylvania and New Jersey are thickly populated, they consume a great deal of milk and in them the dairy industry is highly developed. Nearly all of these States are large importers of cows. However, in upper New England and in western New York and Pennsylvania, cows are raised to be sold to other sections. Pennsylvania purchases each year about 16,000 cows from other States, and if only 3 per cent. were tubercular, it will be seen that many new centers of tuberculosis might be established.

"In order to meet this danger, laws have been enacted by several States requiring all dairy cows and cattle for breeding purposes brought from other States, to be tested with tuberculin. Numerous difficulties are met with in the enforcement of this law, but these are gradually being overcome, and there can be no doubt that the general effect of this protection is most beneficial.

"Among other results, it causes shippers to buy with care and to select sound-looking cows from healthy districts. It also has the effect of making farmers discriminate in the purchase of cattle and to demand tested cows. But there is little advantage in buying healthy cows if they are added to diseased herds. They are so much fresh food for the tubercle bacillus. It is quite as important to extinquish the fires that are burning in our own herds as it is to prevent the entrance of brands from without.

"Tuberculosis of cattle cannot be eradicated by force. Successful measures, unless they are so costly as to make them impossible in most countries, require so much prolonged attention to details, so much and such constant care that unless the owner of the herd and his employes are in sympathy with the work, the most exacting law will fail. But why should not the owner of a tubercular herd be anxious to eradicate the disease and co-operate with the State to this end? He will be, provided the method employed is not more costly and burdensome than the disease itself. This has been demonstrated in Pennsylvania.

"Under the Pennsylvania plan, the State makes no effort to entirely free a herd from tuberculosis, excepting when the owner applies for State aid and agrees to do his part of the work. The owner is required to furnish help during the inspections, to keep the tubercular cattle entirely apart from those that are sound, to disinfect the premises occupied by them, to correct faulty sanitary conditions, and to do all that he is requested to do, and all in his power to keep his herd free from tuberculosis in the future. Under these conditions the State makes the inspection and designates the tubercular and the healthy cattle. The animals in an advanced stage of disease are at once appraised and destroyed. Those showing no clinical evidence

of tuberculosis may also be appraised and destroyed, or they may be established as a separate, quarantined herd, and their milk used or sold after proper pasteurization. To keep tubercular cows alive under these necessary restrictions is the exception. To care for them separately is troublesome, and to dispose of heated milk profitably is difficult. So this method, which is practically the Bang system, is not popular. If our herds were larger and if tubercular cattle were more numerous the farmers' decision on this point might be different.

"If the dogma recently launched by Koch were true, the keeping of tubercular cows in separate herds apart from healthy cattle would at once become more popular, for their milk could then be sold without heating and could be used freely and without question as food for babies and sick people. But as live stock sanitarians, we must not overlook the important fact that bovine tuberculosis is readily transmissible to calves and swine through the milk of tubercular cows, and if this disease is to be checked among farm animals, one of the most important precautions is not to feed tubercular cows milk to animals. This fact is not based on indirect inference and back-handed reasoning, as Koch's dogma is, but is supported by thousands of cases of natural infection and by scores of accurately controlled scientific experiments.

"In addition to the voluntary eradication of tuberculosis as above described, advanced cases and cows with tubercular udders are, wherever found, placed at once in strict quarantine, and are kept in confinement until destroyed.

"This general plan has the entire sympathy and support of the cattle owners of Pennsylvania. Under it in six years nearly 6,000 tubercular cattle have been destroyed and the prevalence of tuberculosis has been reduced more than one-half. There are constantly on file at least three times as many applications for State aid as the appropriation will cover, and as a result a great many herd owners carry out the general plan here outlined, under State supervision, but at their own expense."

ANTHRAX.

Anthrax has persisted in several of the old centers and has appeared this year in a few localities where it was previously unknown. Serious loss has in each case been prevented by vaccination. During the year, 560 animals have been vaccinated on farms where the disease had appeared, either this year or in years past and where, therefore, the animals were imminently exposed.

No animal has died of anthrax after full protection with vaccine until the immunity has expired, after about a year. Several instructive instances of the value of anthrax vaccination have occurred dur-

ing the past season. In one instance, anthrax was known to be endemic on a certain farm and all animals on that farm were vaccinated. The owner bought some young cattle that were not vaccinated, turned them into his pasture and three or four died of anthrax. On another farm anthrax appeared for the first time in 1900. The cattle and horses were vaccinated and there were no losses until the winter of 1901, when one horse died of this disease, thirteen months after vaccination. In repeated instances, many cattle have died of anthrax on a single farm or on several farms along a stream and the disease has stopped completely as soon as vaccination was practiced.

By vaccination it is possible not only to save the animals protected, but it is also possible to prevent the establishment of new centers of infection.

The following law was enacted by the last legislature:

AN ACT

To provide for the prevention of the spread of disease from the carcasses of animals that die of dangerous or virulent diseases, or are killed while afflicted with such diseases; to provide for the safe disposal or destruction of such carcasses; to authorize the State Live Stock Sanitary Board to make regulations for the enforcement of this act; and to provide penalties for the violations under this act, and of the regulations that may be made under it by the State Live Stock Sanitary Board.

"Section 1. Be it enacted, &c., That when any domestic animal may die of, or be killed while afflicted with, an infectious, contagious, germ or parasitic disease, adjudged by the State Live Stock Sanitary Board to be of a dangerous or virulent character, and in particular when any domestic animal may die or be killed while it is afflicted with any one of the diseases known as anthrax, black quarter, hog cholera, swine plague, rabies or glanders, the owner or owners of such animal shall at once destroy or dispose of the carcass of such animal by one of the methods herein provided.

"Section 2. The methods of destruction or disposal shall be of a kind that will completely destroy or securely sequester the poison, germ, parasite or infective agent of the disease with which the animal was afflicted at the time of death. The following methods of destruction or disposal shall be allowed: One. Complete burning or cremation of the carcass, and of all of its parts and products. Two. Boiling the carcass and all of its parts and products in water, or heating the same with steam, at the temperature of boiling water, for at least two hours. Three. Burying the carcass and all of its parts and products in a place that is not subject to overflow from ponds or streams, that

is distant not less than one hundred feet from any water course, well, spring, public highway or building used as a house or stable, and in the following manner, to-wit: The grave shall be of such a depth that when the carcass and the parts and products thereof are placed in it, and the grave is filled with earth and the top is smoothed to the level of the surrounding surface, the uppermost part of the carcass and of its parts and products shall be completely covered; and, further, the grave shall be so protected that the carcass cannot be dug out or exposed by dogs or other animals. Before the carcass and its parts and products are covered with earth they shall be covered with lime, to a depth of not less than three inches. Any other method of destroying or disposing of carcasses, and of the parts and products of carcass, may be practiced that is specifically approved by the State Live Stock Sanitary Board.

"Section 3. If any person owning an animal that dies while it is afflicted with anthrax, black quarter, hog cholera, swine plague, rabies or glanders, or any other infectious, contagious, germ or parasitic disease, that is adjudged by the State Live Stock Sanitary Board to be of a dangerous or virulent character, shall, after notification by anyone neglect within twenty-four hours to destroy or dispose of the carcass and its parts and products in accordance with the provisions of section two of this act, the said person shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than ten dollars nor more than one hundred dollars, at the discretion of the court.

"Section 4. When the carcass and products of any animal that died while afflicted with any of the diseases specified in section one of this act, or of any infectious, contagious, germ or parasitic disease, adjudged by the State Live Stock Sanitary Board to be of a dangerous or virulent character, is not disposed of or destroyed in one of the ways set forth in section two of this act, and this fact shall be brought to the attention of an agent of the State Live Stock Sanitary Board, the board of health of the township, borough or city in which the death occurs, or in which the carcass of the animal may be; or when this fact shall be brought to the attention of any member of such board of health; or in the event that there is no board of health having jurisdiction, when any township auditor, of a township in which such carcass may be, is notified of the fact; it shall be the duty of the said agent of the State Live Stock Sanitary Board, or member of a board of health, or said health board, or said township auditor, to at once cause the carcass and its parts and products to be disposed of or destroyed in accordance with the methods prescribed in section two of this act.

"The disposal or destruction of the carcass shall be carried out in a way that is as economical as is compatible with efficiency and safety,

and a fully itemized bill of the expense incurred shall be drawn up by the agent of the State Live Stock Sanitary Board, the board of health, or the board of township auditors, and forwarded as a voucher to the State Live Stock Sanitary Board. If the voucher is approved by said board, it shall be paid in the same manner as other expenses of said board are paid: Provided, however, That no charge shall be paid of more than ten dollars for the destruction of a single carcass of a horse, mule, cow, bull, or ox; nor more than three dollars for the destruction of a single carcass of a colt, calf, sheep, hog, or dog.

"Section 5. The cost of the destruction of the carcass or carcasses, as hereinbefore provided, shall constitute a lien on the property of the owner or owners of the animals at the time of their death; and it shall be the duty of the State Live Stock Sanitary Board to attempt to recover, and if possible to recover, by due process of law, from said owner or owners for amounts expended by it in disposing of or destroying the carcasses of their animals, in the enforcement of this act."

Approved—The 2d day of May, A. D. 1901.

By this law it is required that the carcasses of animals dead of anthrax shall be disposed of in some safe way. It is highly important that this shall be done with great thoroughness in every instance. The germs of anthrax are present in vast numbers in every drop of blood of animals dead of this disease. As the carcass putrefies and becomes part of the earth, and as fragments of it are spread by birds, by animals or by water or wind, these germs are scattered. They have, through their spores, the most remarkable vitality. They are capable of living in the soil and maintaining their power to produce disease for as long as seven or eight years. Hence, the manifest importance of immediately burning or deeply burying anthrax carcasses and of well disinfecting the places contaminated by them.

As an instance of the importance of early diagnosis, and to illustrate the character of the operations against anthrax, I attach a report on this subject:

"September 1st, 1901.

"Dr. Leonard Pearson, State Veterinarian:

"Sir: I visited the farm of Mr. H. M. Chilson, four miles south of Forksville, on August 29th, with the expectation of obtaining specimens for laboratory research, thinking that the disease affecting his cattle was the same as appeared in Carbon and other counties during the past year.

"When I arrived I found no cattle sick and none had died within the past two days. Mr. Chilson was sick in bed and Dr. B. E. Gamble, the attending physician, told me he believed he was suffering from

anthrax. I found he had a number of large, malignant-looking pustules on his right arm, or rather forearm. I made cultures from these and after reaching the laboratory found I had almost pure cultures of the anthrax bacillus. It appears that when Mr. Chilson's first two animals died, seven days previous to my visit, he removed the hides. He had been working in the oat field the same day and no doubt had scratched his arm and thereby inoculated himself.

"These first two animals were buried, but all subsequent animals were burned immediately after death. I ordered the graves to be burned over with dry brush or straw and then well limed. The hides that were removed had been kept in a box, which I ordered burned, both box and hides. Mr. Chilson has lost five head all told, and Mr. Williams, an adjoining farmer, one head, which had been burned.

"These farms are situated along Loyalsock creek, and I am told there is a tannery at Laporte, about 16 miles up the stream, which may be the source of this outbreak. There is only one farm between this point and Laporte, as most of the country is mountainous.

"Mr. Williams told me the stream had been low and of a filthy character during the latter part of July and the first few weeks in August, then there was high water, which washed back over some of the land where cattle were grazing.

"Very truly,

"SAMUEL H. GILLILAND."

As I have in previous reports discussed at some length the method to be employed in burning and disinfecting on account of anthrax, I shall not go into this subject here.

During the past few years anthrax appears to have become more prevalent in the United States although, unfortunately, there are no general statistics to show the exact situation. During the past year there have been more or less extensive outbreaks of anthrax in Wisconsin, Illinois, the southern part of the valley of the Mississippi and in British Columbia. Since the disease is now so wide spread in the United States, there is the possibility of its occurring anywhere, and stock owners should ever be watchful to require the immediate cremation of any animal dying of a disease resembling anthrax, unless death is known positively not to be from this disease.

BLACK QUARTER or black leg has prevailed to a less extent this year than for several years past. Animals have been vaccinated on infected farms where the disease has prevailed; usually during an active outbreak, and all but two have been protected successfully. It is important in this disease, as it is in anthrax, and it is required by law, that carcasses shall be burned, boiled or safely buried.

VERMINOUS BRONCHITIS OF CALVES. Certain years, and especially following wet seasons, the lung worm of calves (Strongylus micrurus) is common. The young of this parasite live for a time in wet, marshy places whence they are taken by cattle along with grass or water. The young worms then wanders up the oesophagus to the pharynx and then down the wind-pipe to the lungs, where they grow. The eggs and embryos are coughed out and may fall within the reach of other cattle.

Calves are disturbed by this disease very much more than old cattle are. When heavily infected, they cough, breath with difficulty, become emaciated and they may die. After death, the white thread-like worms may be found mixed with mucous and packed into the bronchial tubes.

The treatment consists in the injection of appropriate substances into the trachea, but this is accompanied by some risk, and should only be done by an experienced veterinarian. By feeding concentrated, highly nutritious food and by using a tonic such as iron, one can often carry the calves past the period of greatest development of the parasites, after which they rapidly recover.

This disease is not infrequently mistaken for tuberculosis; its symptoms strongly resemble those of advanced tuberculosis, but the course of the disease and the lesions are quite different and suffice to make it easy to distinguish between them when attention is drawn to the matter.

GLANDERS. Twenty-one cases of glanders have been found in the following counties: Allegheny, Beaver, Bradford, Bucks, Butler, Carbon, Clearfield, Clinton, Cumberland, Franklin, Lancaster, McKean, Philadelphia, Sullivan and Susquehanna. Many more cases were reported that upon investigation proved to be some other disease. In most cases the horses were fresh importations from other States, or they had been stabled closely with glandered horses recently brought from without the State.

It is gratifying to note that there was not a single case of glanders in Luzerne or Lackawanna counties, showing that the rather extensive outbreak there last year was completely up-rooted.

In two instances there were evident attempts to conceal outbreaks of glanders and to surreptitously remove diseased horses. It is fortunate that these attempts did not succeed.

HOG CHOLERA. The losses from hog cholera during the year are estimated at $60,000, as against $100,000 last year. Should more hogs be brought into the State from infected regions, larger losses will result.

Hog raising and feeding are not conducted on anything like as large a scale as natural conditions justify and the inclination of farmers favor. This is due to the great losses from hog cholera in the

past and the fear that the disease will again cause serious depredation if hogs are brought together in large numbers. At distilleries and creameries, hogs are not extensively fed on account of this disease. If an effective vaccine or antitoxine were available for the protection of hogs, a great industry would be added to those existing in this State. It was hoped a few years ago that the investigators of the Bureau of Animal Industry had discovered a preventive; but later results do not appear to have fully sustained the early hopes. There is, however, reason to believe that such a preventive may be found, and if so, it will quickly be made available for the use of the hog raisers of Pennsylvania. At present it is necessary to continue to depend on quarantine, separation and disinfection.

Some outbreaks of fatal contagious disease among hogs are not hog cholera nor swine plague, although resembling these diseases in many respects. Of course an antitoxine or a vaccine effective against hog cholera could not be expected to be effective against this other disease, and so it is important that the contagious diseases of swine shall be studied and more accurately differentiated. This study is now in progress in the laboratory of the State Live Stock Sanitary Board.

Expenditures.

For the fiscal year ending May 31st, 1901, the State Live Stock Sanitary Board had available, $40,000 for use in suppressing diseases of animals. The expenditures under this fund may be classified as as follows: For tubercular cattle, $24,947.50; for glandered horses and mules, $764.75; for inspecting tubercular cattle and herds, $4,-404.38; for inspections for the suppression of diseases other than tuberculosis, and for vaccinating against anthrax and black leg, $3,-771.99; for cremating carcasses, serving quarantine notices, for supplies, postage, office help and miscellaneous expenses, $3,396.79, and for expenses of enforcing the law requiring the inspection of dairy cows and cattle for breeding purposes brought into Pennsylvania, $2,714.59.

Respectfully submitted,

LEONARD PEARSON,
State Veterinarian.

REPORT OF THE ECONOMIC ZOOLOGIST.

Harrisburg, January 1, 1902.

Hon. John Hamilton, *Secretary of Agriculture:*

My Dear Sir: I have the pleasure to present herewith a report of the work done in the Division of Zoology, for the year ending December 31, 1901.

The following act of General Assembly, relating to the protection of trees, shrubs, vines and plants against destructive insects, etc., was passed by the last Legislature:

AN ACT

For the protection of trees, shrubs, vines and plants, known as nursery stock, against destructive insects; providing for the enforcement of this act, the expenses connected therewith, and fixing penalties for its violation.

"Section 1. Be it enacted, &c., That no person shall knowingly or wilfully keep any tree, shrub, vine or plant in any nursery in this Commonwealth, nor knowingly or willingly send out from such nursery any tree, shrub, vine or plant affected with San José Scale or other insect destructive of such tree, vine, shrub or plant.

"Section 2. It shall be the duty of the Secretary of Agriculture to cause an examination to be made, at least once each year, of each and every nursery or other place in this State where trees, shrubs, vines or plants, commonly known as nursery stock, are grown for sale, for the purpose of ascertaining whether the trees, shrubs, vines or plants, therein kept or propagated for sale, are infested with San José Scale or other insect pest destructive of such trees, shrubs, vines or plants. If, after such examination, it is found that the said trees, shrubs, vines or other plants, so examined, are free in all respects from any such dangerously injurious insect pest or pests, the said Secretary, or his duly authorized agent, or other person designated to make such examination, shall thereupon issue to the owner or proprietor of the said stock, thus examined, a certificate setting forth the fact of the examination and that the stock so examined is apparently free from any and all such destructive insect pest or pests.

"Section 3. Should any nurseryman, agent, dealer or broker send out or deliver, within the State, trees, vines, shrubs, plants, buds, or

cuttings, commonly known as nursery stock, and which are subject to the attacks of the insects designated in this act, unless he has in his possession a copy of said certificate, dated within the year thereof, or wrongfully be in possession of said certificate, he shall be guilty of a misdemeanor, and upon conviction shall be punished in accordance with the provisions of section eight of this act.

"Section 4. All nursery stock, as designated in this act, sent out by any nurseryman, agent, dealer or broker within this State, shall be accompanied by a copy of said certificate attached to each box, bale or package. A certificate issued by an official of the United States, setting forth the fact that the nursery stock is free from any and all such destructive insect pest or pests, shall be accepted in lieu of State inspection. Also, empowering all transportation companies to reject all nursery stock not accompanied with a certificate of inspection.

"Section 5. Whenever any trees, shrubs, plants or vines are shipped into the State from some other State, country or province, every package thereof shall be plainly labeled on the outside with the name of the consignor, the name of the consignee, and a certificate showing that the contents have been inspected by a State or government officer, and that the trees, vines, shrubs or plants therein contained appear free from all dangerously destructive insects. When nursery stock is shipped into this State, accompanied by a certificate as herein provided, it shall be held to be prima facie evidence of the facts therein stated, but the Secretary of Agriculture, by himself or his assistants, when they have reason to believe that any such stock is infested with dangerous insects, shall be authorized to inspect the same and subject it to like treatment, as provided in sections six and seven of this act.

"Section 6. If, after examination, it is found that any nursery stock, either in a nursery or sent forth to deliver in this State, if found to be infested with San José Scale or other destructive insect pest or pests, it shall be the duty of the Secretary of Agriculture, by himself or his duly authorized representative or agent, to take means to control, prevent the spread of, or secure the extermination of such insect pest or pests, and shall have power to enter upon premises and order the treatment or destruction of such dangerously injurious insect pest or pests, or the nursery stock infested therewith, giving written notice to the owner or person in charge of the premises or nursery stock so infested. Such notice shall contain a brief statement of the facts found to exist, whereby it is deemed necessary to treat or destroy said trees, shrubs, vines or plants, and shall call attention to the law under which it is proposed to treat or destroy them. In case of objection to the findings of the inspector or agent of the Secretary of Agriculture, an appeal shall be made to the said Secretary, whose

decision shall be final. An appeal must be taken within six days from the service of said notice, and shall act as a stay of proceedings until it is heard and decided.

"Section 7. When the Secretary of Agriculture, or the person or persons appointed by him, shall finally determine, in accordance with the provisions of this act, that any tree or trees, shrubs, vines or other plants, must be treated or destroyed, he shall notify in writing the owner or the person in charge of said infested stock or property, and shall direct him, within a time and in a manner prescribed in such notice, to treat or destroy such infested property. If the person so notified shall refuse or neglect to treat, destroy or disinfect said property, in the manner and within the time prescribed in the said notice, the Secretary shall cause such property to be so treated, and he may employ all necessary assistants for that purpose; and such person or persons, agent or agents, employe or employes, may enter any or all premises in any township, borough or city, necessary for the purpose of such treatment, removal or destruction, and he shall certify to the owner or person in charge of the premises the amount of the cost of said treatment, removal or destruction, and if not paid to him within sixty days thereafter, the same may be recovered together with the cost of action.

"Section 8. Any person violating the provisions of this act or offering any hindrance to the carrying out of this act, shall be adjudged guilty of a misdemeanor, and, upon conviction before a magistrate or justice of the peace, shall be fined not less than ten dollars and not more than one hundred dollars for each and every offense, together with all the costs of the prosecution, and shall stand committed until the same is paid. All necessary expenses, under the provisions of this act, shall, after approval in writing by the Secretary of Agriculture and Auditor General, be paid by the State Treasurer upon warrant of the Auditor General, in the manner now provided by law: Provided, That not more than four thousand dollars shall be so expended for this purpose in any one year.

"Section 9. All penalties and costs recovered for the violation of any of the provisions of this act shall be paid to the Secretary of Agriculture or his agent, and by him be immediately covered into the State Treasury, to be kept as a fund for the use of the Department of Agriculture in the enforcement of the law, and may be drawn out upon vouchers signed by the Secretary of Agriculture and approved by the Auditor General.

"Section 10. The provisions of this act shall not apply to florists' greenhouse plants, flowers and shrubbery, known as greenhouse stock.

"Section 11. This act shall take effect on the first day of August, Anno Domini one thousand nine hundred and one."

Approved—The 10th day of June, A. D. 1901.

This law relating to the inspection of nurseries, will, in time, very materially lessen the loss to the fruit interests of the State, by injurious insects, and will be of inestimable benefit to the purchasers of nursery stock. It is a well known fact that the nursery is one of the greatest distributing agencies of the San José Scale and other destructive insects, and it was for the purpose of striking at the root of this great evil that the passage of the law was so strongly urged. The loss, annually, to farmers and fruit growers in the State by injurious insects and fruit tree diseases is enormous, and the Division of Zoology, working through the law prohibiting nurseries from selling stock that is infested with injurious insects and diseases, hopes to assist in diminishing this loss. The importance of introducing young trees that are free from disease is very manifest, and at the same time lends additional encouragement in an effort to successfully combat such tree diseases that have already gained a foothold. Through the agency of the nursery, diseased stock has been sent into localities free from such, and has introduced, in this manner, dangerous tree diseases heretofore unknown, the complete eradication of which may take years of earnest effort to stamp out.

Under this act it is essential that all shipments of nursery stock, whether from within or without the State, be accompanied by a copy of the certificate of examination by a State or a United States official, having the authority to issue same, showing such stock to be entirely free from the San José Scale and other destructive insects; and also empowering transportation companies to reject all stock not accompanied by a copy of the certificate of inspection.

The following letter was sent to all the transportation companies in the State, with instructions to notify their agents to reject all nursery stock not accompanied by a certificate of inspection:

"Dear Sir: Your attention is respectfully called to the last clause of Section 4 of the act approved the 10th day of June, 1901, a copy of which is herewith enclosed.

"Under this act transportation companies are empowered to reject all nursery stock not accompanied by a certificate of inspection. Will you not notify your agents to refuse to receive nursery stock that does not have attached to it a certificate showing that it is free from San José Scale and other injurious insect pests.

"Very respectfully,

"JOHN HAMILTON,

"Secretary of Agriculture."

Therefore it is apparent that all purchasers of nursery stock should carefully examine all shipments received by them, and see that they are accompanied by the proper certificate of inspection.

The work of the inspection of nurseries began August 1, 1901, and Mr. Enos B. Engle, of Waynesboro, Franklin Co., was appointed to conduct the examinations. After compiling as complete a list as possible of the nurseries of the State, the following letter was mailed to each:

"Harrisburg, August 1st, 1901.

"Dear Sir: Enclosed herewith find copy of Nursery Inspection Law, passed by the last Legislature, and which goes into effect at this date.

"Mr. Enos B. Engle has been appointed Special Agent of the Department of Agriculture, to make inspections. He will enter upon his duties at once, and visit the nurseries as rapidly as possible. All communications with regard to nursery inspection should be addressed to Hon. Benj. F. MacCartney, Economic Zoologist, Harrisburg, Pa.

"Very respectfully,

"JOHN HAMILTON,

"Secretary of Agriculture."

Upon making the first examination of a nursery, the Inspector sent the following report to the Division:

COMMONWEALTH OF PENNSYLVANIA.

Department of Agriculture.

NURSERY STOCK INSPECTORS' REPORT.

................, Pa., ... 190..

Hon. JOHN HAMILTON,

Secretary of Agriculture,

Harrisburg, Pa.:

Dear Sir:

I have this day completed the examination of the Nursery Stock of ...., grown at ...., County of ...., Pennsylvania, and $\left\{\begin{matrix}\text{did not}\\\text{did}\end{matrix}\right\}$ find the San José Scale, or other dangerously injurious insect pest or pests present.

The general condition of the Nursery is ....

It occupies about ....acres; mostly of ....

the specialties being, ...

There { is a / is no } fumigation house on the premises, and stock sent out { is / is not } fumigated.

I, therefore, recommend that a certificate { be / be not } granted.

(Signed) ....

Remarks, Special Agent.

....

....

....

....

....

If the report showed the nursery to be free from San José Scale, and other dangerously injurious insect pest or pests, the following certificate of inspection was immediately forwarded:

COMMONWEALTH OF PENNSYLVANIA.

No.........

DEPARTMENT OF AGRICULTURE.

CERTIFICATE OF INSPECTION OF NURSERY STOCK.

THIS IS TO CERTIFY That the stock in the nursery of ....of .... County of ....State of Pennsylvania, was duly examined in compliance with the provisions of the Act of Legislature of Pennsylvania, approved the 10th day of June, A. D. 1901, and it was found to be apparently free from SAN JOSE SCALE and other dangerous injurious insect pest or pests. This Certificate expires July 31, 190 .

[SEAL.]

Dated Harrisburg, Pa., ...190

....

Secretary of Agriculture.

If the report stated the trees to be diseased, a notice to this effect was sent, with instructions to destroy the infested stock at once; and if upon second inspection the nursery stock was found to be free from San José Scale and other dangerously injurious insect pest or pests a Certificate of Inspection was given. It was necessary, in several instances, to make a third examination before the stock was found to be entirely free from dangerous tree diseases.

The work of inspection was completed about the middle of December, 1901, and shows that there were one hundred and thirty-one nurseries examined. Of the total number, twenty-nine were examined the second time, and five the third time.

Out of the total number inspected, one hundred and twenty-one were granted certificates to sell and ship stock, and ten were refused. Of the thirty-four nurseries having the second and third inspections, there were twenty-six granted certificates. This last statement is of a great deal more importance than is really apparent, and the law accomplishes the part which it is primarily intended. The statement shows that there were twenty-six certificates granted out of a total of thirty-four nurseries having more than one inspection, and sets forth the important fact that these nurseries were subjected to treatment sometime between the first and subsequent inspections, and that all dangerously injurious insect pests were entirely eradicated.

The following is a tabulated form of the counties containing nurseries in the State, with the number of nurseries and acreage comprised in each:

Counties.	Number of nurseries.	Number of acres.
Adams,	33	99½
Allegheny,	2	20
Beaver,	1	8
Bedford,	3	9½
Berks,	3	3¼
Blair,	3	13
Bucks,	6	241
Butler,	1	20
Chester,	7	893½
Crawford,	1	8
Cumberland,	3	101
Dauphin,	3	35½
Delaware,	7	32
Erie,	2	5
Fayette,	1	20
Franklin,	5	6
Huntingdon,	1	½
Juniata,	1	15
Lackawanna,	1	2
Lancaster,	11	76
Lawrence,	4	7½
Lehigh,	1	22
Lycoming,	1	1
Mercer,	4	12
Montgomery,	13	264¼
Northampton,	1	2
Perry,	1	35
Philadelphia,	4	318½
Somerset,	2	21
Venango,	1	6
Westmoreland,	1	10
York,	3	49
Total,	131	2,357

The above table shows that there are two thousand three hundred and fifty-seven acres devoted to the industry alone in Pennsylvania. Twenty of these nurseries, comprising eleven hundred and eighty-five and three-quarter acres, are reported to be in very good condition; sixty nurseries of nine hundred and fifty-six and three quarter acres, are in good condition; thirty-three, aggregating one hundred and six and one-half acres, are in fair condition, and eighteen, comprising one hundred and nine acres, are in indifferent and poor condition. Of the latter, thirteen nurseries of seventy-five and one-quarter acres, are reported to be poorly kept, thus showing a very small percentage of the total acreage to be in poor condition.

Many of the nurseries are equipped with fumigating houses, while others contemplate the erection of similar plants. Hydrocyanic acid gas is used in fumigation.

The Departments of Agriculture of other States having a nursery inspection law, are acting in co-operation with this Department in this matter, and have been of material assistance in carefully watching shipments from this State, of diseased nursery stock, and stock shipped without the certificate of inspection attached thereto.

The office work of the Division has been quite extensive. Hundreds of letters have been received and answered, bulletins sent out, and inquiries relating to various injurious insects and tree diseases have been addressed to persons pertaining to the work of this Division. The sending out of notices relating to nursery inspection to transportation companies, the filing of all reports and the issuing of certificates, have also taken up considerable of our time.

To make mention, briefly, of the many injurious insects sent to the Division for determination and remedial measures, the tent caterpillar was the most prominent. It was abundant in all sections of the State, and was found on both shade and fruit trees. Special attention was given each and every inquiry, and it is to be hoped that the injury caused by this insect will be greatly diminished the coming year.

The Angoumois grain moth, was again troublesome in the eastern section, although it seems to have been less destructive than last year, owing, no doubt to the information given in treating the subject in full, and the general dissemination by this Division during the former troublesome period of this enemy to our grain crops.

Very respectfully,

BENJAMIN F. MacCARTNEY,

Economic Zoologist.

SYNOPSIS OF THE TAX LAWS OF PENNSYLVANIA.

BY THOMAS McCAMANT, *Late Auditor General of Pennsylvania.*

CONSTITUTIONAL PROVISIONS.

"Article IX, Section 1. All taxes shall be uniform upon the same class of subjects, within the territorial limits of the authority levying the tax, and shall be levied and collected under general laws; but the General Assembly may, by general laws, exempt from taxation public property used for public purposes, actual places of religious worship, places of burial not used or held for private or corporate profit, and institutions of purely public charity.

"Article IX, Section 2. All laws exempting property from taxation, other than the property above enumerated, shall be void.

"Article IX, Section 3. The power to tax corporations and corporate property shall not be surrendered or suspended by any contract or grant to which the State shall be a party."

TAXATION FOR STATE PURPOSES.

1. This consists of a tax on the capital stock of corporations, limited partnerships and joint stock associations, domestic and foreign, doing business in the Commonwealth, or having capital or property employed therein, except National banks and incorporated State banks and savings' institutions, and foreign insurance companies; a tax on the shares of stock of National and incorporated State banks and savings' institutions; a tax on the gross receipts of transportation and transmission companies, derived from business done in the Commonwealth, and on the gross receipts of notaries public; a tax on the gross premiums of domestic insurance companies, derived from business done in the Commonwealth; a tax on the premiums of foreign insurance companies, derived from business done in the Commonwealth; a tax on county and municipal loans and the loans of private corporations; bonus on charters; a tax on the

net earnings of private bankers and brokers, and unincorporated banks and savings' institutions, and incorporated savings' institutions without capital stock; a tax on collateral inheritances; a tax on mortgages, judgments and moneys at interest, and on vehicles for hire, and annuities, known as a tax on personal property; a tax on writs, wills, deeds, *et cetera;* mercantile licenses; wholesale liquor licenses; retail liquor licenses; brewers' licenses; distillers' licenses; bottlers' licenses; billiard licenses; eating house licenses; brokers' licenses; auctioneers' licenses; peddlers' licenses; theatre, circus, etc., licenses; a tax or fee on commissions of notaries public; a tax or return of excess of fees collected by county officers, and a return of fees, or tax or licenses, collected by State officers.

2. Settlements of accounts for all of said taxes, and for all moneys due the Commonwealth, save in the case of foreign insurance companies, bonus on charters in most cases, tax on commissions of notaries public, and fees or licenses returned by State officers are made by the Auditor General and State Treasurer, under act of March 30, 1811, relating to the settlement of public accounts, (P. L., 1810-11, page 145), and the several supplements and amendments thereto.

3. In the case of foreign insurance companies, the State Insurance Commissioner collects and returns the tax or license said companies are required to pay, under act of April 4, 1873, (P. L., page 26), and in case of bonus on charters granted under the General Corporation Act of April 29, 1874, and supplements thereto, the Secretary of the Commonwealth collects and pays into the State Treasury either the full amount or the first instalment, before charter is granted or authority to increase capital stock is filed; and in the case of tax or fees on notaries public commissions and fees of State officers, the moneys collected as such are returned directly to the State Treasury, and no settlement is required to be made by the Auditor General and State Treasurer.

4. Settlements for tax on capital stock, gross receipts, gross premiums, bonus on charters, with the exceptions above stated, tax on loans of private corporations, tax on bank stock and tax on matured stock of building and loan associations, are made against the companies owing the tax: settlements for tax on net earnings are made against the bank, banker, broker or corporation owing the tax, and for tax on personal property and county and municipal loans, the settlements are made against the county or municipality liable for the tax; in the case of the collateral inheritance tax, tax on writs, wills, deeds, etc., and the different classes of licenses, as stated, settlements are made against the county officer charged with their collection. A copy of each settlement thus made, show

ing the tax or other moneys due the Commonwealth, is mailed to the treasurer of the corporation, county or municipality, and to the prothonotary, register, recorder or other person owing the tax.*

5. Parties dissatisfied with settlements made against them can appeal therefrom to the court of common pleas of Dauphin county, within sixty days from the date of the copy of settlement mailed them, by filing their appeal with the Auditor General and giving security, as provided in section 11, of the aforesaid act of March 30, 1811; and the act of April 7, 1870, (P. L., page 57), clothes the court of common pleas of Dauphin county with jurisdiction to hear and determine "all suits, claims and demands whatsoever, at law and in equity, in which the Commonwealth may be the party plaintiff, for accounts, unpaid balances, unpaid liens, taxes, penalties, and all other causes of action, real, personal and mixed."

6. Section 12, of the act of March 30, 1811, as aforesaid, makes the amount of every account due the Commonwealth, settled under the said act, a lien from date of settlement on all the real estate of the person or persons indebted, and on their sureties, throughout the Commonwealth, and the act of April 14, 1827, (P. L., 1826-27, page 471), authorizes and requires the Auditor General to send prothonotaries certified copies of said liens, and have them entered of record in the several counties of the Commonwealth. Section 31, of the General Revenue Act of June 1, 1889, (P. L., page 437), makes taxes a lien upon the franchises and property of corporations, companies, associations, joint stock associations and limited partnership, from the time said taxes are due and payable, and provides that in cases of judicial sales taxes due the Commonwealth shall be first allowed and paid before any judgment, mortgage or other claim, and section 14, of the General Revenue Act of June 7, 1879, (P. L., page 119), has in it practically the same provision.

7. Section 30, of the General Revenue Act of June 1, 1889, as aforesaid, (P. L., page 436), makes all balances due the Commonwealth on accounts settled by the Auditor General and State Treasurer bear interest at the rate of twelve per cent. per annum, after sixty days from date of settlement, and any judgment recovered

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*In the case of State tax on personal property, the State Treasurer issues his precept to the Board of Revision of Taxes of the city and county of Philadelphia and to the county commissioners of other counties, authorizing and requiring them to collect the tax with which the county stands charged, and as soon as possible after the close of each year, an account is settled by the Auditor General and State Treasurer against each county, and a copy thereof mailed to the Board of Revision of Taxes of the city and county of Philadelphia and to the county commissioners of the other counties of the Commonwealth.

thereon is to bear interest at the rate of twelve per cent. per annum until paid. Section 3, act of April 9, 1867, (P. L., page 58), makes the same provision as to balances due from corporations.*

8. Payments of moneys due the Commonwealth must be made within sixty days from date of notice of settlement, and section 36, of the act of March 30, 1811, as aforesaid, requires receipts for moneys paid into the State Treasury to be signed by the State Treasurer or some one in his employ and for whom he is answerable; and section 8, of the act of April 10, 1849, (P. L., page 644), requires such receipts to be registered and countersigned by the Auditor General to make them good and effective in law.

9. Auditor General and State Treasurer, or either one, are authorized to examine the books and papers of corporations, institutions, companies, associations and limited partnerships to verify the accuracy of returns made by them.

Act April 28, 1899, section 11, (P. L., page 72).

10. Unless extension of time for payment of indebtedness due Commonwealth is given, by way of payment in instalments, as authorized by section 13, of the aforesaid act of March 30, 1811, accounts unappealed from are, by section 2, act of April 21, 1857, (P. L., page 266), to be certified to the Attorney General for collection, after the expiration of ten days from the sixty day limit within which appeals may be taken; and debtors are required by section 3, act of April 7, 1870, (P. L., page 57), to pay the Attorney General a five per cent. commission, in addition to debt and interest.

11. The financial year of the Commonwealth (the year for which reports of the Auditor General and State Treasurer are made) ends on November 30th. *Resolution of April 21, 1840 (P. L., page 742).* The year for which appropriations are made by the Commonwealth begins on June 1st.

See General Appropriation Act of May 13, 1899, (P. L., page 364), and other General Appropriation Acts passed at previous sessions of the General Assembly.

REGISTRATION.

1. All limited partnerships, banks, joint stock associations, associations, corporations and companies, whether formed, erected, incorporated or organized under the laws of this Commonwealth or any other State, doing business in the Commonwealth, are required

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*Accounts for bonus bear interest at the rate of six per cent.—Alliance Coal Mining Company case, 13 W. N. C., page 324. In the past, six per cent. only has been charged against delinquent county and county officers' accounts.

to register in the office of the Auditor General, under a penalty of $500.

Act June 1, 1889, section 19, (P. L., page 427).

2. Recorders of deeds must certify to the Auditor General the articles of association of limited partnerships and joint stock associations filed in their offices, and for their services, are entitled to a fee of twenty-five cents in each case.

Act June 24, 1895, section 1, (P. L., page 230).

3. Stock brokers, bill brokers, exchange brokers and private bankers, must register with the Auditor General, within sixty days after they commence business, under a penalty of $1,000.

Act June 27, 1895, section 2, (P. L., page 396).

4. Secretary of the Commonwealth to furnish Auditor General an abstract showing name, location, amount of capital stock, and name and address of treasurer of corporations chartered by the Governor.

Act April 29, 1874, section 3, (P. L., page 76).

5. Corporations to notify Auditor General of changes in officers, changes in location of offices, and time and place of meeting of stockholders.

Act June 1, 1889, section 19, (P. L., page 427); act June 8, 1893, (P. L., page 355).

TAX ON CAPITAL STOCK.

1. All corporations having capital stock, and every joint stock association and limited partnership, whether incorporated or organized under the laws of the Commonwealth, or of the United States, or of any other state or territory, or foreign government, doing business and liable to taxation within the Commonwealth, or having capital or property employed or used in this Commonwealth by or in the name of any limited partnership, joint stock association, company, association, corporation, copartnership, person or any other manner, except in the case of banks, savings' institutions, foreign insurance companies, and building and loan associations, are required to make report annually in the month of November to the Auditor General, giving information that will enable the Auditor General and State Treasurer to determine the value of their capital stock for purposes of taxation; and any two of the following named officers, to wit: President, chairman, secretary or treasurer, are required, under oath, to appraise the capital stock at what it is worth, between the first and fifteenth days of November, not less than the average price for which it sold during the year, and not

less than the price or value indicated or measured by net earnings, or by the amount of profit made and either declared in dividends or carried into surplus or sinking fund, and to forward said appraisement, with their oath, and report as aforesaid, to the Auditor General; if the Auditor General and State Treasurer, or either one, are dissatisfied with such report and appraisement, or if no report and appraisement is made, they are authorized to make a valuation of the capital stock upon facts contained in the report or other information in their possession, and settle an account for tax, interest and penalties.

Act June 8, 1891, section 4, (P. L., page 233.)

2. A penalty of ten per cent. is to be added to tax in case of failure to make report and appraisement before December 31, and in case of failure for three successive years to make report and appraisement, the officers so failing are subject to a fine of $500 and imprisonment for a term not exceeding one year, either or both, at the discretion of the court.

Act June 1, 1889, section 22, (P. L., page 431).

3. Corporations, joint stock associations, limited partnerships and companies, from which reports are required, are made subject to and must pay into the treasury of the Commonwealth a tax of five mills on the actual value of their whole capital stock, whether common, special or preferred, such payment to be made within thirty days from settlement of their accounts. Interests in limited partnerships and joint stock associations are deemed capital stock and are taxable as such. Corporations, joint stock associations and limited partnerships liable for capital stock tax, are not required to report to local assessors and pay further tax on securities owned by them in their own right and included within the valuation of their capital stock, but when such securities are held by them otherwise, they are required to report to the local assessors and pay tax thereon the same as individuals.*

Act June 8, 1891, section 5, (P. L., page 236).

4. So much of the capital stock of corporations, limited partnerships, or joint stock associations organized for manufacturing pur-

*Railroad companies whose lines are partly within and partly without the Commonwealth, are taxed on the proportion of their capital stock which the miles of their main track in the Commonwealth bear to the total mileage of the companies; telegraph companies are taxed where the relative value of the tangible property representing capital within and without the Commonwealth cannot be accurately ascertained, on the proportion of their entire capital stock which the length of their lines within the Commonwealth bear to the total length of all their lines; palace car companies, whose cars run into this and other states, are taxed upon the proportion of their capital

poses, as is invested in and actually and exclusively employed in carrying on manufacturing within the Commonwealth, except companies engaged in the brewing or distilling of spirituous or malt liquors, and such as enjoy and exercise the right of eminent domain, is exempt from the payment of tax.

Act June 8, 1893, (P. L., page 293).

5. In the case of fire and marine insurance companies, the tax is at the rate of three mills on each dollar of the actual value of the capital stock.

Act of June 8, 1893, (P. L., page 353).

6. In the case of companies incorporated to maintain a bourse or exchange hall, or a meeting place for merchants or other business men, or for the exhibition of manufactured articles or natural products, that portion of their capital stock that the bourse hall or exchange represents is exempt from taxation; but if in any year a dividend is declared upon the whole capital stock, companies are taxable for such year upon their whole capital stock.

Act June 10, 1893, (P. L., page 417).

7. Companies organized and incorporated to distil liquors and selling the same at wholesale, are required to make report and pay annually a tax of ten mills upon every dollar of the actual value of its capital stock of all kinds.

Act July 15, 1897, section 2, (P. L., page 294).

8. A four mill tax is required to be paid upon full paid, prepaid, and fully matured or partly matured stock of building and loan associations, upon which annual, semi-annual, quarterly or monthly cash dividends or interest is paid, such tax to be deducted from the cash dividend or interest paid, and returned to the State Treasury. Domestic corporations must make report to the Auditor General and foreign corporations to the Banking Department, and said Department must certify to the Auditor General the amount of stock outstanding subject to tax; upon failure to pay tax, the foreign corporation forfeits its right to do business in the Commonwealth; no tax is required to be paid upon matured stock upon which periodical payments are required to be made, or upon such stock after it has matured and is in process of payment.

Act June 22, 1897, section 1, (P. L., page 178).

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stock which the total number of miles traveled in Pennsylvania by their cars bears to the total number of miles traveled by all their cars in all states; bridge companies connecting Pennsylvania with other states are taxed on one-half their capital stock.—Erie R. R. Co. case, (98 P. S. R., page 127); Western Union Tel. case, (15 W. N. C., page 331); Pullman Palace Car case, (107 P. S. R., page 156); Trenton Bridge Co. case, (9 Am. Leg. Reg. O. S., page 298).

TAX ON BANK STOCK.*

1. National and incorporated State banks and savings' institutions with capital stock, to make report to Auditor General, on or before June 20th each year, on oath of president, cashier or treasurer, setting forth number of shares of capital subscribed for or issued and the actual value thereof, ascertained by adding together the amount of capital stock paid in, the surplus and undivided profits, and dividing this amount by the number of shares. Auditor General to satisfy himself of the correctness of such valuation, and to assess a four mill tax on each dollar of the actual value of each share of stock, and to settle and forward each bank a copy of account for tax. Copy of settlement forwarded to bank to be posted, and stockholders notified, and Auditor General to hear any stockholders on the subject of valuation within thirty days after settlement of account. Bank to pay tax within forty days after settlement, from its general fund or collect the same from its shareholders. In case of failure to pay tax, make report or neglect or refusal of officers to appear before Auditor General, if summoned, he shall, after ascertaining value of shares from best information obtainable, assess tax on said shares, add fifty per cent. penalty thereto, and collect the same according to law. Bank responsible for tax in case of neglect or refusal to post copy of settlement giving notice to shareholders. In case bank elects to collect annually from shareholders, the four mill tax on all shares subscribed for or issued, and pay the same into the State Treasury on or before March 1st, the shares and so much of the capital and profits of the bank as are not invested in real estate are to be exempt from local taxation, and such bank shall not be required to make any report to the local assessor or county commissioners of its personal property owned in its own right or pay any tax thereon. In lieu of this rate of taxation, banks may elect to collect and pay into the State Treasury, on or before March 1st, a ten mill tax on each dollar of the par value of all its shares subscribed for or issued, and by so doing the shares, and so much of the capital and profits of the bank as are not invested in real estate, shall be exempt from local taxation.

Act July 15, 1897, section 1, (P. L., page 292).

BANK EXAMINATIONS.

1. To bear the expenses of examination by the Banking Department of the Commonwealth of incorporated State banks, savings' institutions, trust companies, and all corporations having power of

*Shares of National banks located in other States are not taxable in Pennsylvania.—Tappan vs. Merchants' National Bank, 22 Wall., page 490.

receiving money on deposit, each corporation is to pay annually $25. and $5 for every $100,000 or fraction thereof of capital stock it has in excess of $100,000, also two cents for each $1,000 of assets it has; corporations without capital stock to pay $25, and for $1 for each $100,000 or fraction thereof of assets it has in excess of $100,000.

Act February 11, 1895, section 4, (P. L., page 7).

TAX ON GROSS RECEIPTS.

1. All railroad companies, pipe line companies, conduit companies, steamboat companies, canal companies, slackwater navigation companies, transportation companies, street passenger railway companies, and other companies, whether they be corporations, joint stock associations or limited partnerships, doing business in the Commonwealth, and owning, operating or leasing to or from another corporation, company, association, joint stock association or limited partnership, any railroad, pipe line, slackwater navigation, street passenger railway, canal or other device for the transportation of freight, passengers or oil, and all telegraph and telephone companies doing business in the Commonwealth, and all express companies, firms, copartnerships and joint stock associations doing an express business in the Commonwealth, and every electric light company, palace car company and sleeping car company doing business in the Commonwealth, are required to pay an eight mill tax upon each dollar of gross receipts received from passengers and freight transported wholly within the Commonwealth, and from telegraph, telephone and express business done wholly within the Commonwealth, and from business of electric light companies and transportation of oil done wholly within the Commonwealth; said tax to be paid semi-annually on the first days of January and July. Reports are required to be made to the Auditor General every six months of gross receipts received, and for neglect or refusal so to do for a period of thirty days, a ten per cent. penalty is to be added to the tax and collected as other taxes are collected. In cases where works are leased, the tax is to be apportioned according to the terms of the lease, but for the payment of the tax, the Commonwealth first looks to the company operating the works.

Act June 1, 1889, section 23, (P. L., page 431); act April 28, 1899, section 2, (P. L., page 72), as to express companies.

2. Notaries public, except in the city of Philadelphia, are required to pay into the State Treasury, fifty per cent. of their annual gross receipts in excess of $1,500.

Act April 14, 1840, section 3, (P. L., page 335); act March 10, 1810, (P. L., 1809-10, page 80).

Notaries public in the city of Philadelphia are required to pay into the State Treasury on or before December 31st, five per cent. of the gross amount of their receipts, under penalty of forfeiture of their commissions.

Act May 20, 1865, (P. L., page 846).

TAX ON GROSS PREMIUMS.

1. Insurance companies or associations incorporated under the laws of the Commonwealth and doing business therein, except companies doing business upon the purely mutual plan without any capital stock or accumulated reserve, and purely mutual beneficial associations, whose funds for the benefit of members, their families or heirs, are made up entirely of the weekly or monthly contributions of their members and the accumulated interest thereon, are required to make report in writing, through their president, secetary or other officer, to the Auditor General, semi-annually, on the first days of January and July, of their premiums and assessments received during the preceding six months, and to pay into the State Treasury in the last days of January and July an eight mill tax on each dollar of gross premiums received from business transacted within the Commonwealth. This report is to be made under oath, and a ten per cent. penalty is to be added to the account of any company whose officers neglect or refuse, for a period of thirty days, to make report or pay tax.

Act June 1, 1889, section 24, (P. L., page 433); act June 27, 1895, section 1, (P. L., page 409).

FOREIGN INSURANCE COMPANIES.

1. No person can act as the agent or solicitor in this Commonwealth of an insurance company of another State or foreign government, in any manner whatever relating to risks, until the act establishing an Insurance Department has been complied with on the part of the company, and there has been granted by the Insurance Commissioner a certificate of authority showing that the company is authorized to transact business in the Commonwealth; and it is made the duty of every such company to make report to the Insurance Commissioner in the month of January, under oath of its president or secretary, showing the entire amount of premiums received by said company in this Commonwealth during the preceding calendar year, and to pay into the State Treasury a tax of three per cent. upon said premiums; and the Insurance Commissioner shall not renew the certificate of any company until such tax is paid.

Act April 4, 1873, section 10, (P. L., page 26).

2. Tax, as above stated, reduced to two per cent.
Act June 1, 1889, section 24, (P. L., page 433); act June 28, 1895, section 1, (P. L., page 409).

3. One-half the net amount received from tax on premiums of foreign insurance companies is required to be paid the treasurers of cities and boroughs. Such payments to be based upon the return of tax received from companies doing business in cities and boroughs, as shown by the report of the Insurance Commissioner. Warrants for such payments are to be drawn by the Auditor General, payable to the treasurers of the several cities and boroughs entitled to receive the tax.
Act June 28, 1895, section 2, (P. L., page 409).

TAX ON LOANS.*

1. All public loans, except those issued by the Commonwealth, are taxable for State purposes. *Act April 29, 1844, section 32, (P. L., page 497);* all public loans except those issued by the Commonwealth or the United States are made taxable for State purposes, at the rate of four mills on each dollar of the value thereof.
Act June 8, 1891, section 1, (P. L., page 231).†

2. Treasurers of counties, incorporated cities, districts and boroughs, on payment of dividends or interest to any holder or agent claiming the same, on any scrip, bond or certificate of indebtedness issued by said city, district and borough are to assess the tax provided for State purposes upon the nominal value of each and every evidence of debt.‡ This tax is to be deducted by said treasurers on the payment of the interest or dividend, as aforesaid, and to be held by them until paid over to the State Treasurer; and the said treasurers to be subject to the same penalties and liabilities as are prescribed by laws in relation to tax on bank dividends.
Act April 29, 1844, section 42, (P. L., page 501).

3. Treasurers of counties and cities, and burgesses or other chief officer of boroughs and incorporated districts to make return, on oath, to the Auditor General, of the amount of scrip, bonds or certificates of indebtedness outstanding by counties, cities, boroughs and

*This tax is upon the nominal or par value of the loan. Loans held by non-residents are not taxable.—State Tax on Foreign Held Bonds, (15 Wall., page 300, 326).

†Act June 30, 1885, section 1, (P. L., page 193) and act June 11, 1889, section 1, (P. L., page 420), made such loans taxable at the rate of three mills on the dollar, but the act of June 8, 1891, as aforesaid, increased the rate of taxation to four mills on the dollar.

‡This does not relate to school districts.—See case of Wharton vs. School Directors, 42 P. S. R., page 358.

districts, on the first day of January, together with the rates of interest thereon, under the penalty of $5,000, to be settled, sued for and collected as debts due by defaulting public officers are collected. The said treasurers are to deduct the State tax on the payment of interest or dividends on debts due by the county, city, borough or district, and return the same to the State Treasury within thirty days thereafter; and it is made the duty of the Auditor General to settle the accounts of the several treasurers, fix the tax due and unpaid and transmit notice of amount by mail to the officers making returns; and if the amounts due are not paid within sixty days the Attorney General is to sue and collect the same.

Act April 30, 1864, section 4, (P. L., page 219).

4. The scrip, bonds and certificates of indebtedness of any county owned by any public corporation within the county, the income of which is appropriated to the support of the poor and the maintenance of public roads of such county, are exempt from taxation for State purposes.

Act March 24, 1877, (P. L., page 44).

5. Bonds issued by a county for payment of riot losses, are taxable for State purposes at the rate of one-half mill on the dollar.

Act June 1, 1881, (P. L., page 37).

6. All loans issued by any corporation created under the laws of the Commonwealth, or of the United States, or of any other State or government, including car trust securities and loans secured by bonds or any other form of certificate or evidence of indebtedness, whether the interest be included in the principal of the obligation or payable by the terms thereof, are taxable for State purposes at the rate of four mills on the dollar. Act June 8, 1891, section 1, (P. L., page 231).*

7. The treasurer of each private corporation incorporated under the laws of the Commonwealth or any other State of the United States, doing business in the Commonwealth, upon the payment of any interest on any scrip, bond or certificate of indebtedness issued by such corporation to residents of this Commonwealth and held by them, to assess the tax provided for State purposes upon the nominal value of each and every evidence of said debt, and to report, on oath, annually, on the first Monday of November, to the Auditor General, the amount of indebtedness of the corporation owned by the residents of the Commonwealth as nearly as the same

*Act June 30, 1885, section 1, P. L., page 193), and act June 1, 1889, section 1, (P. L., page 420), made corporate loans taxable at the rate of three mills on the dollar. The act of June 8, 1891, as aforesaid, increased this rate of tax to four mills on the dollar.

can be ascertained, and to deduct the four mill tax on every dollar of the interest paid as aforesaid, and to pay the same into the State Treasury within fifteen days after the 31st day of December, each year; his compensation for this service to be the same as city and borough treasurers for similar services, and for failure to assess and pay over the tax a penalty of ten per cent. is to be added to the tax of the corporation in default.

Act June 30, 1885, section 4, (P. L., page 194).

8. Compensation of treasurers of corporations for assessing and collecting tax on corporate loans is five per cent. on the first $1,000 or fraction thereof; one per cent. on the second $1,000 or fraction thereof, and one-half per cent. on all sums in excess of $2,000.

Act April 15, 1834, section 42, (P. L., 1833-34, page 344); act April 5, 1842, section 11, (P. L., page 239).

BONUS ON CHARTERS.

1. Every company chartered under the General Corporation Act of April 29, 1874, or accepting the same, or under any general or special law, except building and loan associations, and corporations not for profit, is required to pay into the State Treasury a bonus of one-third of one per cent. upon the amount of its authorized capital stock, and a like bonus upon any subsequent authorized increase of capital stock; and a similar bonus is to be paid upon the authorized increase of capital stock of companies heretofore incorporated. The company is not to exercise any corporate powers or go into operation, nor is the Governor to issue letters patent until such bonus is paid, and the Secretary of the Commonwealth is not to file proceedings for increase of capital stock until he is satisfied such bonus is paid.

Act June 15, 1897, (P. L., page 156); act May 3, 1899, section 1, (P. L., page 189).*

2. In cases of reduction of capital stock, under the twenty-third section of the General Corporation Act of April 29, 1874, corporations are not liable in the aggregate for a greater bonus than one-fourth of one per cent. upon the capital as altered and reduced.

Act May 22, 1878, (P. L., page 97).†

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*See the following previous acts as to payment of bonus, to wit: Act May 1, 1868, section 15, (P. L., page 113); act March 22, 1887, section 10, (P. L., page 13); act May 7, 1889, (P. L., page 115).

†See act May 29, 1885, section 15, (P. L., page 36), as to natural gas companies.

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TAX ON NET EARNINGS OR INCOME.

1. Stock brokers, bill brokers and exchange brokers, and private bankers, are required to make a sworn return to the Auditor General, on or before the first Monday of December, annually, setting forth the total amount of their receipts from commissions, discounts, abatements, allowances, and all other profits arising from their business, during the year that ended on November 30th, immediately preceding date of return, and to forthwith pay into the State Treasury three per centum upon the aggregate amount contained in such return; the revenues derived from this source to be appropriated to the State sinking fund.

Act June 27, 1895, section 1, (P. L., page 397).

2. Penalty for neglect or refusal to make said return, and to register with the Auditor General, is $1,000, to be settled and collected as taxes on bank dividends are settled and collected.

Act June 27, 1895, section 3, (P. L., page 398).

3. All corporations and limited partnerships, foreign or domestic, doing business in the Commonwealth, and not subject to tax on capital stock or gross premiums, except incorporated banks and savings' institutions with capital stock and foreign insurance companies, are required to make report, on oath of some officer, annually upon the first Monday of November, of their net earnings or income received from all sources during the preceding year, and to pay into the State Treasury within sixty days thereafter, three per cent. upon such annual net earnings or income, in addition to any tax on personal property to which they may be subject. For neglect or refusal to make report on or before December 31st, such corporations and limited partnerships are liable to a penalty of $1,000, to be added to their tax. Manufacturing companies not subject to this tax.

Act June 1, 1889, section 27, (P. L., page 435).

4. All incorporated savings' institutions without capital stock are required to pay $25, and $1 for every $100,000, or fraction thereof, of assets they have in excess of $100,000, to bear the expenses of examination of their accounts by the State Banking Department.

Act February 11, 1895, section 4, (P. L., page 7).

TAX ON COLLATERAL INHERITANCES.

1. All estates, real, personal and mixed, of every kind, situated within the Commonwealth, whether the person or persons dying, seized thereof, be domiciled within or out of the Commonwealth, and all such estates situated in another State or territory, or country, when the person or persons dying, seized thereof, shall have their

domicile within the Commonwealth,* passing from any person who may die seized or possessed of such estate either by will or under the intestate laws of the Commonwealth, or any part of such estate or estates or interest therein transferred by deed, grant, bargain, or sale, made or intended to take effect in possession or enjoyment after the death of the grantor or bargainor, to any person or persons, or to bodies corporate or politic, in trust or otherwise, other than to or for the use of father, mother, husband, wife and children and lineal descendants born in lawful wedlock, or the wife or widow of the son of the person dying seized or possessed thereof, are made subject to a tax of five dollars on every one hundred dollars of the clear value of such estate or estates, and at and after the same rate for any less amount, to be paid to the use of the Commonwealth; and all owners of such estates, and all executors and administrators and their sureties, can only be discharged from liability for the tax, by paying the same over for the use of the Commonwealth. Estates of less value than $250 not subject to tax.

Act May 6, 1887, section 1, (P. L., page 79).

2. Bequests, devises and residuary legacies to executors in lieu of commissions, to be taxed on all amounts in excess of what courts consider fair compensation for services rendered.

Act May 6, 1887, section 2, (P. L., page 79).

3. Tax on reversionary interests not payable nor interest chargeable, until actual possession is acquired. Tax to be assessed on value of estate at time right of possession accrues to owner. Owner may, however, pay tax before coming into possession, if he desires to do so; and in such cases, the basis for assessment of the tax is the value of the estate at the time of payment of tax, after deducting the value of life estates or estates for years. Tax on real estate to be a lien until paid. Owners of the personal estate to make return of the same to the register of wills within one year from the death of the decedent, and enter security for the payment of the tax; otherwise, tax to be immediately payable and collectible.

Act May 6, 1887, (P. L., page 80).

4. A discount of five per cent. is allowed on tax paid within three months after death of decedent. If not paid at end of one year from death of decedent, twelve per cent. interest to be charged. In cases of unavoidable delay from claims, litigation or other cause, whereby an estate or part thereof cannot be settled within one year from death of decedent, only six per cent. interest chargeable on tax due from the unsettled portion of the estate; and where such unsettled estate,

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*Real estate and tangible personal property situated without the Commonwealth not subject to tax. Bittinger's Estate, 127 P. S. R., page 338.

or portion thereof, is not productive of six per cent. interest, parties entitled to the same only to pay such interest as they realize from the estate during the time tax is withheld.

Act May 6, 1887, section 4, (P. L., page 80).

5. Tax on pecuniary legacies and distributive shares, if in money, to be deducted and paid by executors, administrators and trustees; if not money, payment of tax to be demanded by executors, administrators or trustees upon appraised value of such legacies or distributive shares, and they not compelled to pay or deliver legacies or distributive shares, except on payment of tax. On failure to pay tax, specific legacy or article subject to tax, or portion of the same, to be sold at public sale, after notice to legatee, and balance to be distributed as directed by law. Tax retained by executors and administrators or paid into their hands, to be promptly paid over.

Act May 6, 1887, section 5, (P. L., page 80).

6. If legacy is for a limited period, upon a condition or contingency, tax to be retained upon whole amount, if in money; but if not in money and apportionment is necessary, orphans' court to make apportionment of same to be paid by legatees, and for further order relative thereto.

Act May 6, 1887, section 6, (P. L., page 81).

7. When legacy is a charge on real estate, heir or devisee to deduct tax before paying legacy, and pay the amount so deducted to the executor. Tax to remain a charge on real estate until paid, and payment to be enforced by orphans' court in same manner that payment of legacy is enforced.

Act May 6, 1887, section 7, (P. L., page 81).

8. Executors and administrators to notify register of wills of real estate subject to tax, within six months after they enter on their duties, or if the fact be not known to them within that time, then, within one month after they have knowledge of the same; and owners of estates subject to tax, upon the vesting of the estate to give immediate information to register of wills.

Act May 6, 1887, section 8, (P. L., page 81).

9. Duplicate receipts for payment of tax to be taken by executors and administrators, one to be sent to the Auditor General, who shall charge the register of wills receiving the tax with the amount of the same, countersign the receipt and seal the same with the seal of his office and return to executor or administrator sending the receipt to him. The receipt so sealed and countersigned is a proper voucher in the settlement of accounts of executors and administrators, but in no event are they to be credited in their accounts with

the payment of the tax unless receipts for the same are sealed and countersigned by the Auditor General.

Act May 6, 1887, section 9, (P. L., page 81).

10. On assignment or transfer of stocks and loans subject to tax, the same to be paid at time of transfer to register of wills of county where transfer is made; otherwise, corporation permitting the transfer, to be liable for the tax.

Act May 6, 1887, section 10, (P. L., page 82).

11. Where portions of legacies paid have to be refunded to pay debts proven against an estate, after tax has been paid, a proper proportion of said tax is to be refunded, if not paid into State Treasury.

Act May 6, 1887, section 11, (P. L., page 82).

12. Registers of wills to appoint an appraiser to fix valuation of estates subject to tax as often as occasion requires. Appraiser to make a fair and conscionable appraisement, and to fix the cash value of all annuities and life estates growing out of an estate, the tax upon which shall be payable immediately. Persons dissatisfied with appraisement may appeal, within thirty days, to orphans' court, on paying or giving security to pay costs and whatever tax court fixes. Court to determine all questions of valuation and liability of estate for tax, with right of appeal to Supreme Court.

Act May 6, 1887, section 12, (P. L., page 82).

13. Appraisers of estates not to take fees or rewards from executors, administrators, legatees, next of kin or heirs; for so doing registers of wills to dismiss them from service, and on conviction for such offense they are to pay a fine not exceeding $500 and be imprisoned not exceeding one year, either or both, at discretion of court.

Act May 6, 1887, section 13, (P. L., page 82).

14. Registers of wills to record in book returns made by appraisers, and may give certificates of payment of tax from such record; and they are to furnish monthly statements of appraisements to the Auditor General, and the Auditor General to record such statements. Taxes remaining due and unpaid for one year to be collected through proceedings in the orphans' court, on bill or petition of registers of wills to enforce payment.

Act May 6, 1887, section 14, (P. L., page 83).

15. Orphans' court authorized to cite executors and administrators of delinquent estates to file account, or cite executors, administrators or heirs to show cause why tax should not be paid. Notice to be published when personal service cannot be had. If tax found

to be due and unpaid, delinquents to pay the same and costs. Register of wills or Auditor General to employ an attorney of the proper county to sue for and recover delinquent tax; and Auditor General to allow registers of wills, in the settlement of their accounts, costs of advertising and other reasonable fees and expenses incurred in collection of tax.

Act May 6, 1887, section 15, (P. L., page 83).

16. Registers of wills, on filing bond with the Auditor General, to be agents of Commonwealth for collection of tax, and for their services in collecting tax they are allowed to retain for their own use five per cent. upon amount of tax collected, if the same amounts to less than $200,000 in any one year, or four per cent. upon the amount collected if the same is $200,000, and less than $300,000 in any one year, or three per cent. upon the amount collected if the same is $300,000, or more in any one year.

Act May 14, 1891, (P. L., page 59).

17. Registers of wills to give bond, with two or more sureties, in such amount as the orphans' court may direct, conditioned for the faithful performance of their duties, and for the accounting and paying over tax collected. Bond, on its execution and approval by orphans' court, to be forwarded to Auditor General.

Act May 6, 1887, section 17, (P. L., page 84).

18. County treasurers to collect tax until bond is given by registers of wills.

Act May 6, 1887, section 18, (P. L., page 84).

19. Registers of wills to make monthly returns to Auditor General of moneys received for use of Commonwealth, and pay same into State Treasury.

Act May 24, 1893, section 1, (P. L., page 125).

20. Neglect to make return and payment, to work a forfeiture of commissions, and subject delinquents to a ten per cent. penalty on their accounts.

Act May 14, 1893, section 2, (P. L., page 125).

21. Twelve per cent. interest to be paid on delinquent accounts.

Act May 24, 1893, section 4, (P. L., page 125); act May 6, 1887, section 19, (P. L., page 84).

22. Lien of tax to continue until same is paid, but is limited to property chargeable with the tax. Tax to be sued for within five years after due and demandable, otherwise presumed to be paid, and to cease to be a lien against purchasers of real estate.

Act May 6, 1887, section 20, (P. L., page 84).

23. Appraisers of estates subject to tax to be allowed $2 per day, and necessary traveling expenses, to be itemized, sworn to, and be subject to approval of Auditor General.

Act June 26, 1895, section 1, (P. L., page 326).

24. Expert may be appointed appraiser where interests of Commonwealth require the services of the same. Registers of wills to certify to the Auditor General the necessity for the services of expert appraisers, and such appointments not to be made without approval of Auditor General. Additional compensation may be allowed experts, but no payment for such service to be made until itemized statement of services rendered and compensation recommended is rendered, under oath, to Auditor General for his approval. Clerks or employes in offices of registers of wills not to be appointed as experts.

Act June 26, 1895, section 2, (P. L., page 326).

25. Tax erroneously paid may be refunded, when it is made to appear to the proper courts that estates are not subject to tax on account of lineal heirs being subsequently discovered.

Act March 22, 1899, (P. L., page 20).

26. Tax erroneously paid in other cases may be refunded on satisfactory proof of such erroneous payment rendered State Treasurer by registers of wills, but applications for re-payment must be made within two years from date of payment.

Act June 12, 1878, (P. L., page 206).

TAX ON PERSONAL PROPERTY.

1. All personal property of the classes hereinafter enumerated, owned, held or possessed by any person, persons, copartnership, or unincorporated association or company, limited partnership, bank or company, resident, located or liable to taxation within the Commonwealth, or by any joint stock company or association, limited partnership, bank or corporation whatsoever, formed, erected, or incorporated by, under or in pursuance of any law of the Commonwealth or of the United States, or of any other State or government, and liable to taxation within the Commonwealth, whether such personal property be owned, held or possessed by such person or persons, copartnership, unincorporated association, company, joint stock company or association, limited partnership, bank or corporation, in his, her, their or its own right, or as active trustee, agent, attorney in fact or in any other capacity, for the use, benefit or advantage of any other person, persons, copartnership, unincorporated association, company, joint stock company or association, limited partnership, bank or corporation, is made taxable at the rate of four

mills on each dollar of the value thereof, and no failure to assess or return the same shall discharge such owner or holder from liability for tax thereon, to wit: All mortgages, all moneys owing by solvent debtors, whether by promissory note, or penal or single bill, bond or judgment; all articles of agreement and accounts bearing interest; all public loans whatsoever, except those issued by this Commonwealth or the United States;* all loans issued by or shares of stock in any bank, corporation, association, company, or limited partnership, created or formed under the laws of the Commonwealth or of the United States, or of any other state or government, including car trust securities and loans secured by bonds or any other form of certificate or evidence of indebtedness, whether the interest be included in the principal of the obligation or payable by the terms thereof, except shares of stock in any corporation or limited partnership liable to tax on capital stock or relieved from payment of tax on capital stock; all moneys loaned or invested in other states, territories, the District of Columbia or foreign countries; all other moneyed capital in the hands of individuals citizens of the Commonwealth. This section not to apply to building and loan associations, nor to bank notes, or notes discounted or negotiated by any bank, banking company, savings' institution or trust company.

Act June 8, 1891, section 1, (P. L., page 231).

2. Board of revision of taxes in Philadelphia and county commissioners in other counties, to furnish assessors annually with blanks supplied by Auditor General; and assessors to furnish taxables with said blanks, and on them returns of property subject to taxation are to be made. Returns to be sworn to by taxable persons, and in case of copartnerships, unincorporated associations, and joint stock associations and companies by some member thereof, and in case of limited partnerships and corporations by the president, chairman or treasurer. Where business is done by a corporation, joint stock association or limited partnership in more than one county, return is required to be made only in the county where the principal office is located. Obligations of public or private corporations, the tax upon which is required by law to be collected from the holders of such obligations and paid into the State Treasury by the corporations themselves, are not to be included in returns.† Prior laws

*County and municipal loans, and loans of private corporations are taxable at their nominal or par value. All other loans, school bonds included, are taxable at their actual value.

†Obligations of public and private corporations referred to are county and municipal loans and loans of private corporations. School bonds are not returned by the district that issued them; they must be included in the return made by a taxable.

relating to the collection of the tax upon such obligations to remain in force.

Act June 1, 1889, section 2, (P. L., page 421).

3. Affidavit to return of taxables, to be made before assessor, or person authorized to administer oaths. Oaths to set forth that return is full, true and correct. Making false returns punishable by a fine not exceeding $500, imprisonment not exceeding seven years, and disqualification from ever being a witness.

Act June 1, 1889, section 3, (P. L., page 422).

4. Assessors authorized to administer oath to taxables, free of charge; and for accepting return not sworn to or charging for oath, they are subject to a fine not exceeding $500.

Act June 1, 1889, section 4, (P. L., page 422).

5. Assessors to make return from best information obtainable, on failure of taxables to make same, after ten days' notice. To examine lists of judgments and mortgages, and charge defaulters with amount of liens and interest, and add thereto taxable property coming to their knowledge from other sources. Returns to be revised by county commissioners and board of revision of taxes, from records in their offices, and evidence secured from persons and papers, in form prescribed by Auditor General. Fifty per centum to be added to revised and estimated returns. Taxables may substitute sworn return for estimated one, on or before day fixed for appeals from assessments, by presenting satisfactory reasons for not previously making return.

Act June 1, 1889, section 5, (P. L., page 422).

6. Assessors and taxables arranging to make false returns to be guilty of conspiracy, and on conviction to be sentenced to pay a fine not exceeding $1,000, and to imprisonment not exceeding three years.

Act June 1, 1889, section 6, (P. L., page 423).

7. Recorders of deeds to keep daily record of mortgages and articles of agreement to secure payment of money, and of assignments of the same, and to file the same monthly with county commissioners and board of revision of taxes.

Act June 1, 1889, section 7, (P. L., page 424).

8. Prothonotaries to keep daily record of judgments and other instruments to secure debt that are entered of record, and file the same, monthly with county commissioners and board of revision of taxes.

Act June 1, 1889, section 8, (P. L., page 424).

9. County commissioners and board of revision of taxes to certify to proper county record of mortgages and judgments held by non-residents, and also record of satisfaction, when satisfied.

Act June 1, 1889, section 9, (P. L., page 424).

10. County commissioners and board of revision of taxes to furnish assessors' statement of mortgages and judgments filed with them.

Act June 1, 1889, section 10, (P. L., page 425).

11. Assessors to compare returns of taxables with statement furnished by county commissioners and board of revision of taxes, and note any excess of taxable property in making their returns to county commissioners and board of revision of taxes.

Act June 1, 1889, section 11, (P. L., page 425).

12. County commissioners and board of revision of taxes to charge taxables with excess of taxable property returned to them by assessors, and notify taxables of the same, and that the increase of valuation is subject to appeal.

Act June 1, 1889, section 12, (P. L., page 425).

13. County commissioners, board of revision of taxes, assessors, recorders of deeds and prothonotaries failing to discharge duties imposed upon them, to be subject to a fine not exceeding $500 and imprisonment not exceeding one year.

Act June 1, 1889, section 13, (P. L., page 426).

14. County commissioners and board of revision of taxes to cause to be assessed annually upon stages, omnibuses, hacks, cabs and other vehicles used for transporting passengers for hire, except steam and street passenger railway cars, and upon annuities yielding annually over $200, a tax of four mills on each dollar of the value thereof.

Act June 8, 1891, section 2, (P. L., page 232).

15. Auditor General to furnish county commissioners and board of revision of taxes with blanks, books, notices and papers.

Act June 1, 1889, section 15, (P. L., page 426).

16. Three-fourths of the taxes based on returns made to the State Board of Revenue Commissioners and actually paid into the State Treasury, to be returned to counties, in payment of expenses incurred in assessing and collecting the tax; and in consideration thereof no claim is to be made on the Commonwealth for abatements, tax collectors' commissions, extraordinary expenses incurred, uncollectible taxes, or for keeping record of judgments and mortgages.

Act June 8, 1891, section 3, (P. L., page 232).

17. Counties and cities to collect tax, and on first Monday of September to pay into State Treasury what is then collected, and the balance on second Monday of November immediately following. Ten per cent. penalty to be added to all taxes due and unpaid by a county or city on second Monday of November, to be charged against each delinquent taxpayer; and city and county treasurers are permitted to retain for their own use from the gross sum of money paid by them into the State Treasury the commissions named and prescribed by existing laws.*

Act June 1, 1889, section 17, (P. L., page 426).

18. Lenders of money not to require borrowers to pay tax, and in cases where borrowers pay tax, the same to be considered usury, and to be subject to the laws governing the same.

Act June 1, 1889, section 18, (P. L., page 427).

19. Auditor General, State Treasurer and Secretary of the Commonwealth made a board of revenue commissioners to equalize assessments and taxes for use of Commonwealth.

Act May 24, 1878, section 1, (P. L., page 126).

20. County commissioners and board of revision of taxes to send State Treasurer for use of board of revenue commissioners sworn statement of property subject to taxation for State purposes, as returned to them by assessors, and to answer, on oath, interrogatories and inquiries addressed to them by board of revenue commissioners. Failure to furnish statement or answer interrogatories to be a misdemeanor and be punishable as such; and statement and answers may be compelled by mandamus.

Act May 24, 1878, section 2, (P. L., page 126).

21. Board of revenue commissioners to determine value of property made taxable by law, adjusting and equalizing the same, so as to make all taxes bear equally upon all property subject to taxation for State purposes in proportion to its actual value; to ascertain value of items subject to a specific tax, and quality and value of classes of property liable to an *ad valorem* tax, and when so ascertained to make a statement of the same, assigning to each county the quantity and value of taxable property therein, and the quota of tax to be raised therefrom.

Act May 24, 1878, section 3, (P. L., page 126).

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*Compensation of county and city treasurers is one per cent. on the amount of tax paid into the State Treasury. Act June 11, 1840, section 7, (P. L., page 614); act May 13, 1856, section 9, (P. L., page 569). Tax is paid on the issuing of the State Treasurer's precept under act May 24, 1878, section 5, (P. L., page 127).

22. Record of valuation to be made by board of revenue commissioners in duplicate, and one copy filed with Auditor General and State Treasurer.

Act May 24, 1878, section 4, (P. L., page 127).

23. State Treasurer to send copy of record of valuation to county commissioners and board of revision of taxes, and issue his precept requiring them to collect tax on the amount of valuation and property ascertained to be liable for taxation; and in cases of increase in valuation of property subject to taxation, statement of quota or amount of tax due on account of such increase is to be transmitted to county commissioners and board of revision of taxes, and they are to collect and pay into the State Treasury the sum fixed by the board of revenue commissioners.

Act May 24, 1878, section 5, (P. L., page 127).

24. Counties aggrieved by action of board of revenue commissioners may appeal to court of common pleas of Dauphin county. Court to fix time of hearing, and notice to be served on Auditor General and State Treasurer thirty days before hearing.

Act May 24, 1878, section 7, (P. L., page 128).

25. Court to hear and determine proceedings on appeal.

Act May 24, 1878, section 8, (P. L., page 128).

26. Court to ascertain errors and certify amount of same to Auditor General, who shall give credit therefor to counties.

Act May 24, 1878, section 9, (P. L., page 128).

27. Appeals not to suspend or postpone collection of taxes.

Act May 24, 1878, section 10, (P. L., page 129).

28. Board of revenue commissioners to keep journal of proceedings and report to Legislature.

Act May 24, 1878, section 11, (P. L., page 129).

29. Tax collected on any excess of valuation to belong to counties.

Act May 24, 1878, section 12, (P. L., page 129).

30. Board of revenue commissioners to receive a salary of $300 for each member.

Act May 24, 1878, section 13, (P. L., page 129).

TAX ON WRITS, WILLS, DEEDS, ET CETERA.

1. Prothonotaries of courts of common pleas, recorders of deeds and registers of wills are required to demand and receive from parties applying for process or services sums as follow hereafter, to be taxed in bill of costs, to abide the event of suits, and to be paid by the losing party.*

Act April 16, 1830, section 1, (P. L., 1829-30, page 272).

*No tax to be allowed on any appeal or on any writ or process issued out of the Supreme or Superior Court. Act May 19, 1897, section 3, (P. L., page 68).

2. Prothonotaries to demand and receive on every original writ, except the writ of habeas corpus, and on the entry of every amicable action, the sum of fifty cents; on every writ of *certiorari* issued to remove the proceedings of a justice of the peace or alderman, fifty cents; on every entry of judgment by confession or otherwise, where suit has not been previously commenced, fifty cents; on every transcript of a justice of the peace or alderman, twenty-five cents.

Act April 6, 1830, section 3, (P. L., 1829-30, page 273).

3. Recorders of deeds to demand and receive for every deed, mortgage or other instrument of writing offered to be recorded, fifty cents.

Act April 6, 1830, section 4, (P. L., 1829-30, page 273).

4. Registers of wills to demand and receive for probate of a will and letters testamentary thereon fifty cents, and for granting letters of administration, fifty cents.

Act April 6, 1830, section 5, (P. L., 1829-30, page 273).

5. Recorders of deeds to collect for use of Commonwealth on each of the following commissions, $10, as follows: Health officer, lazaretto, physician and port physician, Philadelphia; prothonotary, clerk of oyer and terminer, clerk of quarter sessions, clerk of orphans' court, register of wills, recorder of deeds and sheriff.

Act April 6, 1830, section 7, (P. L., 1829-30, page 274).*

6. Prothonotaries, recorders and registers to give bond to Commonwealth for collection of tax.

Act April 6, 1830, section 9, (P. L., 1829-30, page 274); act March 15, 1832, section 1, (P. L., 1831-32, page 135); act April 14, 1834, section 76, (P. L., page 355).

7. Court of common pleas in each county to appoint an auditor to audit accounts of county officers for tax and fees due Commonwealth, and make report to the Auditor General. Auditor to receive from county treasury $1.50 per day for his services, except in Philadelphia, where compensation is $2 per day; and Auditor General may appoint an additional auditor for Philadelphia, at $2 per day, payable out of State Treasury, and he shall also fill all vacancies and make appointments where court neglects to do so.

Act April 14, 1846, section 10, (P. L., page 415); act March 15, 1847, section 1, (P. L., page 354); act March 27, 1848, section 1, (P. L., page 270).

8. County officers to make monthly returns of moneys collected for Commonwealth and monthly payments into State Treasury.†

Act May 24, 1893, section 1, (P. L., page 125).

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*See act February 10, 1851, (P. L., page 50), as to Sullivan county.

†See section 4, act April 6, 1871, (P. L., page 477), as to Allegheny county.

9. For failure to make returns and payments, as aforesaid, they forfeit fees, and are subjected to a ten per cent. penalty to be added to tax.

Act May 24, 1893, section 2, (P. L., page 125).

10. Books may be examined and accounts settled Fifty per cent. to be added to accounts for neglect to make returns, and if amount be not paid within fifteen days, said accounts are to bear interest at twelve per cent. Auditor General and State Treasurer may instruct Attorney General to proceed against sureties.

Act May 24, 1893, sections 3 and 4, (P. L., page 125).

MERCANTILE LICENSES.

1. Retail vendors or dealers in goods, wares or merchandise to pay an annual license of $2 and one mill additional on each dollar, gross, of business done annually. Wholesalers to pay $3 and one-half mill on each dollar, gross, of business done annually. Dealers or vendors at a board of trade or exchange to pay twenty-five cents on each $1,000, gross, of goods sold.

Act May 2, 1899, section 1, (P. L., page 184).

2. Persons who sell to dealers and vendors, to be classed as wholesalers, and all others as retailers.

Act May 2, 1899, section 2, (P. L., page 184).

3. County commissioners to appoint mercantile appraiser annually, on or before December 30th. In cities of first class, Auditor General and city treasurer to appoint five appraisers, all of whom shall not belong to one party, and who shall serve for three years.

Act May 2, 1899, section 3, (P. L., page 184).

4. Auditor General to prepare and furnish mercantile appraisers with blanks to be distributed to vendors or dealers; to contain request for information as to volume of business done; report to be sworn to and volume of business done during the calendar year to be the basis for rating the license.

Act May 2, 1899, section 4, (P. L., page 184).

5. Blanks to be filled and returned to appraiser within ten days from receipt of same; failure to do so, to be reported to county treasurer; and treasurer then to require owner or business manager to appear before him with books and accounts for examination, and he may issue subpoenas and attachments to compel attendance of owners and others, and production of books, to secure information as to business done; and to settle account for tax found due. Refusal to produce books and papers and appear before treasurer, to be punished by a fine of $1,000. Treasurer to settle an account

against owners neglecting to make report, and send them certified copy of settlement; settlement to be subject to appeal for thirty days, and to be final if not appealed from. Treasurer to collect accounts not appealed from.

Act May 2, 1899, section 5, (P. L., page 185).

6. Appraiser to forward blanks to vendors or dealers ten days before he visits their places of business, and to visit them personally, require them to make returns of sales, and to administer oaths to them; if dissatisfied with returns made, he to ascertain and assess license, and leave notice specifying classification, amount of license to be paid, and time and place where appeal will be held. Appeal to be held by county treasurer and appraiser, save where there is a board of appraisers, who shall hear appeals. Vendors or dealers dissatisfied with the rating of mercantile appraiser to have right of appeal to county treasurer and mercantile appraiser, who are required to hear them; and if dissatisfied with finding of county treasurer and mercantile appraiser or board of mercantile appraisers in reference to their classification, they can appeal to court of common pleas, which shall hear and determine appeal within twenty days, or at its next sitting. On failure to attend appeal, no defence to be set up in suits for recovery of license that could have been heard on appeals.

Act May 2, 1899, section 6, (P. L., page 186).

7. Unpaid licenses to be sued for within ten days after July 1st, by county treasurer, but if he is satisfied license cannot be collected he shall make report thereof to Auditor General, and give reasons, and Auditor General may exonerate him from collection of license, and in that case no suit to be brought.* Licenses to be paid to State Treasurer monthly.

Act May 2, 1899, section 7, (P. L., page 187).

8. Failure of mercantile appraiser to visit places of business and furnish notice of classification and license, to be punished by a fine of $100.

Act May 2, 1899, section 8, (P. L., page 187).

9. Assessors to certify to county treasurers lists of dealers and vendors, and corrected list to be certified to Auditor General by county treasurer.

Act May 2, 1899, section 9, (P. L., page 187).

10. Commissions of county and city treasurers, fees and mileage, and laws relating to advertising lists, to remain as now fixed by law.

Act May 2, 1899, section 10, (P. L., page 188).

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*See act March 11, 1870, (P. L., page 374), as to Allegheny county.

11. After publication of lists, constables to report to county treasurer all omissions from list, and to receive a fee of fifty cents for each omission reported.

Act May 2, 1899, section 10, (P. L., page 188).

12. Dealers to have signs on places of business, under penalty of $10 for not doing so.

Act May 2, 1899, section 11, (P. L., page 188).

13. Retailers commencing business after date licenses are issuable, to take out license for fraction of year, at rate of $20 for whole year, but full license required, unless persons commencing business, as aforesaid, do not, within one month after such commencement, apply for and take out license.

Act April 7, 1830, section 6, (P. L., page 389); act March 4, 1824, section 5, (P. L., 1823-24, page 34).*

14. License to be taken out for each store.

Act March 24, 1824, section 3, (P. L., page 33).

15. Manufacturers and mechanics not having a store or warehouse separate and apart from manufactory or workshop, exempt from payment of license.

Act February 27, 1868, section 1, (P. L., page 43).

16. Manufacturers and mechanics selling goods, wares and merchandise other than their own manufacture, in excess of the annual value of $500 to pay license.

Act April 9, 1870, (P. L., page 59).

17. Farmers selling their own produce, or occupying stalls in a market or sidewalk, not required to pay license in cities of first class.

Act April 18, 1878, section 5, (P. L., page 28). See also case of Barton vs. Morris, 1 W. N. C., page 543, holding that farmers cannot be rated and made pay license for selling produce in a market.

18. Mercantile appraisers to receive a fee of fifty cents on each certificate of license granted (to be collected from person to whom license is issued) and six cents per mile, circular, for each mile necessarily traveled in the discharge of their duties. In Philadelphia county, they receive sixty-two and one-half cents for every name returned by them to the city treasurer, to be paid and deducted from the amount collected for the State for licenses, and three cents per mile for each mile necessarily traveled in the discharge of their

*Licenses under said act of April 7, 1830, date from May 1st, but as returns, under act of May 2, 1899, have to be made for the calendar year, it is questionable whether licenses can now be taken out for a fraction of a year under acts of April 7, 1830, and March 4, 1824.

duties; the same mileage is also allowed in the county of Allegheny. Appraisers must make affidavit to their accounts for mileage, and such accounts are paid out of the State Treasury on the warrant of the Auditor General.

Acts February 27, 1865, (P. L., page 4); May 24, 1871, section 3, (P. L., page 1127; April 22, 1846, section 12, (P. L., page 489); April 11, 1862, section 3, (P. L., page 493), and April 15, 1850, section 8, (P. L., page 472).

19. Mercantile appraisers' list to be published by county commissioners in three newspapers of general circulation in each county, one of which is to represent the minority party of the two principal political parties of the county, and one of which may be a German or Welsh paper, but such list need not be published in more than two newspapers if the county commissioners desire to limit the same. In cities of the first class Auditor General and City Treasurer to direct list to be published in four newspapers. In Berks county, the list is to be published in four newspapers, two of which are to be newspapers printed in the German language.

Act April 20, 1887, section 1, (P. L., page 60); act April 23, 1867, (P. L., page 1307).

20. Newspapers to be allowed usual rates of advertising charged to private customers for such publication, not to exceed thirty cents per line for four insertions. Amount paid for advertising not to exceed ten per cent. of moneys received the preceding year from class of licenses advertised. Bills to be certified to county treasurer by appraiser, and treasurer to pay same; and, on approval by Auditor General, to receive credit for amount paid in settlement of his account with the Commonwealth.

Act April 20, 1887, section 2, (P. L., page 60).

21. All State accounts to be audited by Auditor General.

Act April 20, 1887, (P. L., page 60).

22. To be no pay for advertising, nor fee to appraisers, for fictitious name or names of persons not residing at places designated.

Act April 20, 1887, section 4, (P. L., page 60).

23. Appraisers to give notice in Philadelphia that licenses must be taken out on or before June 25th.

Act April 18, 1855, section 1, (P. L., page 244).

24. Appraisers in Philadelphia to sit as a board of appeals for thirty days after first publication of list, to correct erroneous assessments; on expiration of thirty days, and after list has been finally adjusted and placed in hands of city treasurer, said treasurer to appoint collectors, not exceeding six in number, to collect delinquent licenses, and ten per cent. additional for their services.

Act April 13, 1866, section 2, (P. L., page 104).

25. If payment is not made within thirty days after demand made, the amount thereof to be levied by distress and sale.
Act April 13, 1866, section 3, (P. L., page 104).

26. Appraisers to furnish list to county or city treasurers, and copy to be transmitted to Auditor General within thirty days thereafter; and treasurers to collect the licenses from the persons charged with the same, together with his own fee and the fees of appraisers.
Act April 16, 1845, section 8, (P. L., page 534).

27. Amount of licenses to be charged to county and city treasurers, and they not to be discharged therefrom (if not exonerated by Auditor General) unless suits are brought for their recovery, and pressed to judgment and execution, and the amount paid into State Treasury on or before October 1st.
Act April 11, 1862, section 3, (P. L., page 493).

28. Licenses to be paid to county treasurer.
Act May 11, 1853, section 11, (P. L., page 673).

29. Treasurers to keep book account of moneys received for licenses.
Act March 4, 1824, section 4, (P. L., 1823-24, page 34).

30. Licenses to be sued for and recovered by action of debt, with right of appeal.
Act April 11, 1862, section 4, (P. L., page 493).

31. Neglect of duty by aldermen and others to be punished by fine of $100.
Act March 4, 1824, section 7, (P. L., 1823-24, page 34).

32. In Pittsburg and Allegheny cities, the city treasurer collects mercantile licenses, and he is required to give bond to the Commonwealth by act of February 18, 1871, section 1, (P. L., page 88).

33. In Scranton city, the city treasurer collects mercantile licenses
Act March 30, 1867, section 7, (P. L., page 632).

34. In Carbondale city, city treasurer collects licenses.
Act May 4, 1857, section 1, (P. L., page 387).

WHOLESALE LIQUOR LICENSES.

1. Wholesale liquor dealers to pay for the use of the Commonwealth for licenses in cities of first and second class, $1,000; in cities of the third class and all other cities, $500; in boroughs, $200; in townships, $100. Licenses to be paid into State Treasury within ninety days.
Act July 30, 1897, section 1, (P. L., page 468).

2. To be licensed for one year by courts of quarter sessions.
Act June 9, 1891, (P. L., page 257).

3. Rectifiers, compounders, storekeepers or agents not included in any other classification for license, and who have stores, offices or places of business in the Commonwealth, are required to pay the same license as wholesale dealers.
Act July 30, 1897, section 1, (P. L., page 468).

RETAIL LIQUOR LICENSES.

1. Persons licensed to sell at retail any vinous, spirituous, malt or brewed liquors, or any admixture thereof in any house, room or place, hotel, inn or tavern, to pay in cities of first and second class, $1,000; in cities of third class, $500; in other cities, $300; in boroughs, $150; in townships, $75. To be paid to county treasurers for use of counties in the following proportions: In cities, the sum of $100; in boroughs and townships, one-fifth of amount of licenses to be paid to treasurers of counties for use of counties, and the balance to treasurers of cities, boroughs and townships for their respective use; the money paid in township treasuries to be applied to repair of roads.
Act June 9, 1891, (P. L., page 428).

2. Licenses to be granted by courts of quarter sessions, and in cities of first class mercantile appraisers are to receive a fee of $2.50, to be collected from the applicant for license.
Act May 13, 1887, (P. L., pages 108, 109).

3. Retail liquor dealers to pay an additional license for use of Commonwealth, as follows: $100 in cities of first and second class; $50 in other cities; $50 in boroughs; $25 in townships.
Act July 30, 1897, section 2, (P. L., page 469).

BREWERS' LICENSES.

1. Brewers to pay annual license fee according to the production of their breweries, graded on the number of barrels produced the preceding year. Each brewery to be licensed separately, and new breweries to pay for first year $1,000. The graded license of brewers runs from $250 on breweries producing less than 1,000 barrels annually to $6,000 on those produicng more than 300,000 barrels annually. They are to produce satisfactory evidence to the court of quarter sessions or State Treasurer when they make application for license of the number of barrels they brewed the preceding year. State Treasurer to license brewers of malt and brewed liquors who sell to licensed dealers only the product of their breweries in pack-

ages of not less than twelve pint bottles, or in casks of not less than one-eighth barrel. The price of such license is $1,000, and the license is to be framed and exposed in view in the brewery licensed. Other brewers to be licensed by court. Brewers and distillers permitted to deliver their product within the county where licensed, and their delivery wagons to have marked on the side the name of the licensee and the number of the license in letters and figures not less than four inches long.

Act July 30, 1897, (P. L., page 464).

DISTILLERS' LICENSES.

1. Distillers like brewers are to pay an annual license fee according to the production of their distilleries, graded on the number of barrels produced the preceding year. New distillers to pay for first year $1,000. The graded license of distillers runs from $100 on distilleries producing less than 50 barrels annually, to $2,000 on those producing more than 20,000 barrels annually. Distillers are licensed by courts of quarter sessions, and not by State Treasurer, but other provisions relating to brewers are applicable to distillers.

Act July 30, 1897, (P. L., page 464).

BOTTLERS' LICENSES.

1. Bottlers to pay an annual license fee of $500 in cities of first and second class; $350 in other cities; $350 in boroughs; $125 in townships.

Act July 30, 1897, section 1, (P. L., page 468).

2. To be licensed by court of quarter sessions.

Act June 9, 1891, (P. L., page 257).

BILLIARD LICENSES.*

1. Billiard rooms, bowling saloons and ten pin alleys to be licensed annually, under penalty of fine not exceeding $500 or imprisonment not exceeding three months.

Act April 10, 1849, section 19, (P. L., page 573).

2. License to be $30 for first table or alley, and $10 for each additional table or alley; but no license to be paid on such tables or alleys connected with institutions for relief of insane or diseased persons, and in possession of private individuals who have them not for pay or public use.

Act May 15, 1850, section 2, (P. L., page 772); act April 14, 1851, section 9, (P. L., page 570).

*Pool is but a variation of the game of billiards, and keepers of pool tables are liable for license.—Willems vs. Commonwealth, 12th W. N. C., page 471.

3. In Bedford, Carbon and Monroe counties, and at Cresson Springs, Cambria county, Loretto Springs, same county, and Ephrata Springs, in Lancaster county, license is at rate of $2.50 per month for every month the billird room, bowling saloon or ten pin alley is in use.

Act April 3, 1852, section 6, (P. L., page 281); act March 22, 1860, (P. L., page 229); act April 5, 1862, (P. L., page 276); act February 27, 1863, (P. L., page 77); act April 10, 1867, (P. L., page 1076).

4. One-half the fines for keeping billiard rooms, bowling saloons and ten pin alleys without license to be for use of prosecutor, and the other half for use of Commonwealth.

Act May 15, 1850, section 4, (P. L., page 772).

5. No license to keep billiard room, bowling saloon or ten pin alley to be granted in Wyoming county.

Act April 27, 1852, section 6, (P. L., page 468).

6. Bagatelle tables to be licensed in Allegheny county. Rate of license is $5 annually for each table, together with a fee of 50 cents for the county treasurer and 37½ cents for the mercantile appraiser. Keeping tables without license, punished by a fine of not less than $10, nor more than $100, but such tables can be used in institutions for the insane and diseased without license.

Act May 11, 1853, section 9, (P. L., page 673).

7. Mercantile appraiser to return to county treasurer all persons keeping tables.

Act June 11, 1853, section 10, (P. L., page 673).

EATING HOUSE LICENSES.

1. Keepers of eating houses, restaurants, oyster cellars or other places where refreshments are sold, and not liquors, to be licensed annually, if their sales amount to $500. They are to be rated by the mercantile appraiser and to pay license varying from $5 to $200, in proportion to the sales they make annually.

Act April 10, 1849, sections 20, 21, 22 and 23, (P. L., page 547).

BROKERS' LICENSES.

1. Stock brokers, bill brokers, exchange brokers, merchandise brokers and real estate brokers, to be licensed annually, and to pay therefor three per cent. upon their annual receipts from commissions, discounts, abatements, allowances, or other similar means used in the transaction of their business.

Act May 15, 1850, section 7, (P. L., page 773).

2. Mercantile appraisers to assess brokers, according to the amount of business done, in the same manner as required in case of vendors of merchandise, subject to right of appeal.

Act May 15, 1850, section 8, (P. L., page 773).

AUCTIONEERS' LICENSES.

1. Auctioneers to be rated with merchandise brokers, and to pay in the same manner as brokers, three per cent. upon their annual receipts from commissions, abatements, discounts, allowances or other means used in the transaction of their business. In Philadelphia the license not to be less than $500.

Act June 26, 1873, (P. L., 1874, page 332).

PEDDLERS' LICENSES.

1. Persons disabled from procuring a livelihood by labor may be licensed to peddle, for which license they are required to pay to travel on foot, $8; with one horse and wagon, $16, and with two horses and wagon, $25. No license to extend further than the county for which it was granted, save wholesale peddlers, who are required to pay for license to travel with one horse and wagon, $40, and with two horses and wagon, $50.

Act April 2, 1830, (P. L., 1829-30, page 147); act April 16, 1840, (P. L., page 433).

2. Punishment for peddling without license or refusing to show license is a fine of $20.

Act May 9, 1889, (P. L., page 150).

3. Disabled soldiers and sailors permitted to peddle without license on following conditions: Production of pension certificate as evidence of disability, or certificate from a United States examining surgeon that a living cannot be procured by manual labor, and a certificate from a prothonotary that affidavit has been filed with him setting forth that the soldier or sailor desiring to peddle is the owner, in his own right, of all the goods he proposes to peddle. These certificates and the soldier's or sailor's discharge from United States service, are evidence of right to peddle.

Act June 9, 1891, (P. L., page 250).*

*The special laws relating to peddling, passed prior to the adoption of our present State Constitution, are too numerous to give. Some prohibit peddling altogether, others require a special license for a county or city, and others place conditions and limitations on the granting of a license. The only safe rule to be observed by any one who desires to peddle is to make inquiry of the treasurer of a county wherein he proposes to peddle what requirements and restrictions there are on peddling in that county.

THEATRE, CIRCUS, ETC., LICENSES.

1. Owners and lessees of buildings fitted up and used for theatrical or operatic entertainments or for the exhibition of museums, to pay an annual license as follows: $500 in cities of first class, $100 in cities of second class, $75 in cities of third class, and $30 in boroughs and townships.

For circuses and menageries the license to be the same as is required for theatres, and when exhibited in a building the license is to be paid by the owner of the building. When exhibited in a tent or similar enclosure, the license is to be paid by the proprietor of the circus or menagerie. The proprietor of a circus or menagerie exhibiting in a tent or enclosure can take out a yearly license for the entire State, on the payment of $1,000. Licenses for theatres, circuses and menageries to be issued by county treasurers. Penalty for exhibiting without license is a fine not less than $100 nor more than $500.

Act June 24, 1895, section 1, (P. L., page 249).

DUTIES OF COUNTY TREASURERS.

1. Each county treasurer, before entering on the duties of his office, to give bond to be approved by two of the judges of the court of quarter sessions in such penalty as the judges shall deem sufficient, condition for the faithful discharge of all duties enjoined on him in behalf of the Commonwealth, and for the payment according to law, of all moneys received by him for the use of the Commonwealth. Bond to be acknowledged, recorded and forwarded to Auditor General.

Act April 15, 1834, section 34, (P. L., 1833-34, page 543).

2. State Treasurer may require new bond in case of death of sureties, or in cases of insolvency or failing circumstances.

Act May 7, 1855, section 75, (P. L., page 507).

3. County treasurer to act as the agent of the State for the collection of the several classes of licenses, as aforesaid; to keep separate accounts of all moneys received by him on behalf of the Commonwealth.

Act April 15, 1834, section 38, (P. L., page 543).

4. To make monthly returns and payments of moneys received for use of Commonwealth. Failure to do so to work a forfeiture of commissions, and a ten per cent. penalty to be added to amount due.

Act May 24, 1893, section 1, (P. L., page 125).

5. On failure to make monthly returns and payments, books and accounts may be examined, and an account settled by Auditor Gen

eral and State Treasurer, and fifty per cent. to be added to any amount found due.

Act May 24, 1893, section 3, (P. L., page 125).

6. Account may be placed in hands of Attorney General, and to bear twelve per cent. interest from fifteen days after settlement, or sureties may be proceeded against immediately.

Act May 24, 1893, section 4, (P. L., page 125).

7. County auditors to settle and adjust the accounts of the county treasurer with the State Treasurer.

Act April 15, 1834, section 49, (P. L., 1833-34, page 546).

8. To send copy of report to Auditor General.

Act April 15, 1834, section 59, (P. L., page 547).

9. Appeal may be taken from report to court of common pleas.

Act April 15, 1834, section 56, (P. L., page 547).

10. In Allegheny county, the auditor appointed by court to audit the accounts of the prothonotary, audits the account of the county treasurer for licenses, and the county comptroller for State tax on personal property.

Act May 1, 1861, section 18, (P. L., page 454).

11. Treasurer may be removed from office for failure to transmit bond to Auditor General.

Act April 15, 1834, section 36, (P. L., 1833-34, page 543).

12. Bond to be delivered up one year after settlement of his accounts.

Act April 1, 1835, (P. L., 1834-35, page 101).

13. Commissions of county treasurers for moneys collected on behalf of the Commonwealth are five per cent. where the amount does not exceed $1,000; one per cent. when the amount exceeds $1,000 and does not exceed $2,000, and one-half per cent. on all sums in excess of $2,000. Act April 15, 1834, section 42, (P. L., 1833-34, page 544). On State tax on personal property, he is allowed one per cent. on amount paid into State Treasury.

Act June 11, 1840, section 7, (P. L., page 614); act May 13, 1856, section 9, (P. L., page 569).

NOTARIES PUBLIC COMMISSIONS.

1. Governor authorized to appoint as many notaries public as in his judgment the interests of the public may require, but $25 to be paid into State Treasury for each commission issued.

Act February 19, 1873, (P. L., page 36).

FEES OF PUBLIC OFFICERS.

1. Prothonotaries, clerks of courts of quarter sessions and orphans' courts, registers of wills and recorders of deeds, to pay into State Treasury, after deducting clerk hire and office expenses, fifty per centum on any excess of fees over and above $2,000 received by them annually. If one person holds one or more of said offices, the fees received from the several offices held to be aggregated, and fifty per cent. of the excess over and above $2,000, and necessary clerk hire and office expenses, to ascertain and report to the Auditor General all excess of fees received, as aforesaid. Act April 2, 1868, section 8, (P. L., page 11); act May 6, 1874, section 1, (P. L., page 125); act March 10, 1810, (P. L., 1809-10, page 79), as to counties not covered by acts of April 2, 1868, and May 6, 1874, as aforesaid. This latter act provides for return to State Treasury of fifty per cent. of all fees received annually in excess of $1,500.*

2. Attorney General to pay into State Treasury all commissions received by him in excess of $7,000 per annum.

Act April 7, 1870, section 3, (P. L., page 58).

3. For fees and licenses to be collected and paid into State Treasury by the Insurance Commissioner, see act April 4, 1873, sections 6 and 7, (P. L., page 25); act May 1, 1876, sections 38 and 45, (P. L., pages 64, 65).

4. For fees to be collected and paid into State Treasury by the Secretary of the Commonwealth, Secretary of Internal Affairs, Auditor General and State Treasurer, see act April 27, 1871, (P. L., page 242); April 15, 1873, (P. L., page 75); April 1, 1837, (P. L., 1836-37, page 132), and April 22, 1846, (P. L., page 486).

5. Health officer, Philadelphia, to collect and pay into State Treasury for certificates of health issued by him to steam vessels arriving from foreign ports, $10; to sailing vessels, $5, and to coasting vessels arriving from ports south of Saint Mary river, $2.50.

Act June 5, 1893, section 6, (P. L., page 298).

MISCELLANEOUS.

1. The Commonwealth receives some revenue annually from estates of persons who die intestate, and without known heirs or kindred. In all such cases, said estates escheat to the Commonwealth.

For law regulating escheats, see act May 2, 1889, (P. L., page 66).

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*In Allegheny county, under act of April 6, 1871, (P. L., page 416), and in Philadelphia county, under act of March 31, 1876, (P. L., page 13), the fees received by county officers belong to the county. Commonwealth vs. William B. Mann, et al., 168 P. S. R., page 290; Commonwealth vs. Allegheny county, 168 P. S. R., page 303.

2. Deposits in savings' institutions remaining unclaimed for thirty years, to escheat to Commonwealth.

Act April 17, 1872, (P. L., page 62).

3. There is paid into the State Treasury annually certain sums of money for analyzing commercial fertilizers, but as the moneys thus paid in are used to defray the cost of the analysis made, they cannot properly be considered a revenue of the Commonwealth.

The act providing for the analysis of fertilizers is the one of June 28, 1879, (P. L., page 180).

4. Persons, firms and corporations manufacturing and selling oleomargarine, butterine or any similar substance, are required to be licensed by the Department of Agriculture, and the moneys received for such licenses are to be paid into the State Treasury, but as they are used as a special fund by the Department of Agriculture in detecting and suppressing frauds in the sale of butter, they cannot, like the moneys received for analyzing fertilizers, be considered a general revenue of the Commonwealth.

The act regulating the sale of oleomargarine and butterine, and providing for licenses is the one of May 5, 1899, (P. L., page 241).

5. To aid in the building of the low grade railroad, extending from the mouth of the Mahoning creek, in Armstrong county, to the mouth of Bennett's Branch creek, in Cameron county, $3,500,000 of bonds were taken from the sinking fund of the Commonwealth, and in lieu thereof, bonds of like amount, of the Allegheny Valley Railroad Company, were substituted.

These bonds are guaranteed by the Philadelphia and Erie Railroad Company, the Northern Central Railway Company and the Pennsylvania Railroad Company, and they are dedeemable at the rate of $100,000 per year, and the interest on the balance, at five per cent. per annum, is payable until all are redeemed. These bonds and the revenue derived therefrom constitute an asset of the sinking fund, applicable to the payment of the interest and reduction of the principal of the State debt.

Act of March 30, 1869, (P. L., page 730).

6. Under the operation of what are known as the Humes Acts of June 6, 1883, (P. L., page 75), and June 23, 1885, (P. L., page 140), the Commonwealth has $2,775.00 of United States four per cent. registered bonds that were purchased with surplus moneys in the general fund of the State Treasury. These bonds and the interest received thereon also constitute an asset of the sinking fund, applicable to the payment of the interest and reduction of the principal of the State debt.

7. The New York and Erie Railroad Company, now the New York, Lake Erie and Western Railroad Company, was required, by section 5, act March 26, 1846, (P. L., page 181), to pay into the treasury of the Commonwealth annually the sum of $10,000 for the privilege of passing through portions of Pike and Susquehanna counties with its lines of railroad, but such annuity is now to be returned, on warrant of the Auditor General, to the said two counties.

Act May 11, 1899, (P. L., page 289).

8. The Commonwealth also receives small revenue from fines, penalties and other miscellaneous sources, under different acts of Assembly.

TAXATION FOR COUNTY PURPOSES, OR COUNTY RATES AND LEVIES.

1. The subjects of taxation for county purposes are all real estate, to wit: Houses, lands, lots of ground and ground rents, mills and manufactories of all kinds, furnaces, forges, bloomeries, distilleries, sugar houses, malt houses, breweries, tan yards, fisheries, ferries, wharves, and all other real estate not exempt by law from taxation;* also horses, mares, geldings, mules, and neat cattle over the age of four years; and all offices and posts of profit, professions, trades and occupations, and all single freemen above the age of twenty-one years, who do not follow any occupation or calling.

Act April 29, 1844, section 32, (P. L., page 497); act April 15, 1834, section 4, (P. L., 1833-34, page 512).

2. No tax in any county to exceed the rate of one cent on every dollar of the adjusted valuation.

Act April 15, 1834, section 7, (P. L., 1833-34, page 512).

3. Where valuation of taxable property as fixed by last triennial assessment has been raised to more than three hundred and fifty per cent. above its former valuation, no county, special county or building tax to exceed in the aggregate three and one-half mills on

*Corporations of a public or quasi public character that must have the right of eminent domain in order to perform their functions, such as canal companies, railroad companies and gas companies, are not subject to local taxation on so much of their real estate and other property as is indispensably necessary to the exercise of their corporate privileges. Lehigh Coal and Navigation Co. vs. Northampton Co., 8 W. & S., page 334; Railroad vs. Berks Co., 6 P. S. R., page 70; Coatesville Gas Co. vs. Chester Co., 97 P. S. R., page 476. In Philadelphia, railroad property, (superstructure of road and water stations only excepted) are subject to taxation for city purposes. Act April 21, 1858, (P. L., page 385). In Pittsburg, real estate of a railroad company is subject to taxation for city purposes.—Act January 4, 1859, section 3, (P. L., page 828).

the dollar of the valuation, shall be levied without approval of court of quarter sessions.

Act May 24, 1878, section 2, (P. L., page 134).

4. County commissioners to make estimate of probable expenses for ensuing year, at first meeting after general election.*

Act April 15, 1834, section 1, (P. L., 1833-34, page 571).

5. To issue precepts to assessors every three years, requiring them to return list of taxable persons and property, together with a just valuation of the same; said valuation to continue until next triennial assessment.

Act April 15, 1834, section 2, (P. L., 1833-34, page 511); act April 22, 1846, section 16, (P. L., page 490); act May 15, 1841, section 6, (P. L., page 395).

6. Assessors to be sworn, and form of oath to be taken herein given.

Act May 15, 1841, section 2, (P. L., page 393); act July 27, 1842, section 9, (P. L., page 445).

7. Objects of taxation to be assessed according to actual value, and at such rates as the same would sell separately, and county commissioners may raise or reduce assessments, but not to impose a different rate per centum on different townships; and all rates to be levied on assessments as returned and corrected.

Act May 15, 1841, section 4, (P. L., page 394).

8. Real estate encumbered by ground rents, dower or mortgage to be estimated at its full value, and ground rents to be assessed against owners, unless it is stipulated that lessee shall pay the taxes.

Act May 15, 1841, section 7, (P. L., page 395); act April 1, 1845, section 1, (P. L., page 280).

9. Real estate that has been improved between periods of triennial assessments, to be re-assessed.

Act April 10, 1849, section 34, (P. L., page 577).

10. All real estate to be assessed that was omitted at triennial assessment.

Act April 28, 1868, (P. L., page 105).

11. Timber lands to be returned separately.

Act June 13, 1883, (P. L., page 112).

12. Assessors to make returns in interval between triennial assessments, noting changes occasioned by transfer of real estate, destruction of buildings, new inhabitants, et cetera.

Act April 15, 1834, section 11, (P. L., 1833-34, page 513).

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*See section 5, act of June 8, 1893 (P. L., p. 394), as to counties with a population of 150,000 or over.

13. Assessors to make returns in cases where false ones have been made by taxables, and persons aggrieved may appeal, and county commissioners may make an abatement, if they deem the same proper.

Act May 15, 1841, section 5, (P. L., page 394).

14. Assessors subject to a fine not exceeding $200 and imprisonment not exceeding twelve months for failing to assess persons and property, and for assessing property and taxable objects at a greater or less value than they know the same to be worth. In Allegheny county, court of common pleas empowered to cite delinquent assessors to make returns, and remove them from office for failure to do so, and appoint others in their places.

Act May 15, 1841, section 3, (P. L., page 394); act April 15, 1869, (P. L., page 981).

15. To be subject to a fine not exceeding $40 for not complying with precept issued to them.

Act April 15, 1834, section 24, (P. L., 1833-34, page 515).

16. Assessors subject to a penalty of $20 for refusing to serve, but not to be chosen for second term without their consent during a period of ten years.

Act February 28, 1835, section 2, (P. L., 1834-35, page 45).

17. Tax to be apportioned among the different wards, townships and districts, but not to exceed in one year one cent on the dollar of the adjusted valuation, and to be lowered in proportion as the tax on property is lower than one cent on the dollar.

Act April 15, 1834, section 7, (P. L., 1833-34, page 512).*

18. Transcripts of assessments to be made out and transmitted to assessors on or before second Monday of April, together with statement of rate per cent. and day of appeal.

Act April 15, 1834, section 8, (P. L., 1833-34, page 512).

19. Assessors to give taxable notice of their ratings, and of time and place of appeal.

Act April 15, 1834, section 9, (P. L., 1833-34, page 513).

20. County commissioners to give three weeks notice, by advertisement in newspapers, of time and place of appeal.

Act April 15, 1834, section 10, (P. L., 1833-34, page 513).

21. Assessors to give notice to taxables in years following triennial assessment, in cases of destruction of buildings and improve-

*See section 2, act May 24, 1878, *ante*, for cases where valuations have been raised more than three hundred and fifty per cent.

ments, new inhabitants in districts, and changes in valuation of personal property.

Act April 15, 1834, section 12, (P. L., 1833-34, page 513).

22. County commissioners to attend appeals, hear persons applying for redress, and grant relief, if complaint appears reasonable and just; but no abatements to be made in years other than one in which triennial assessment is made, except in case of destruction of buildings and improvements.

Act April 15, 1834, section 13, (P. L., 1833-34, page 513).

23. Assessors to attend appeals, to prevent impositions from being practiced on county commissioners.

Act April 15, 1834, section 14, (P. L., 1833-34, page 514).

24. Assessments to be regulated according to alterations made, and duplicates thereof to be made.

Act April 15, 1834, section 15, (P. L., 1833-34, page 514).

25. County commissioners to hear appeals at subsequent times before payment of tax, but appellant to give notice to the proper assessor.

Act April 15, 1834, section 16, (P. L., 1833-34, page 514).

26. County commissioners to constitute a board of revision. To be sworn and deposit oath in office of recorder of deeds.

Act July 27, 1842, section 10, (P. L., page 445).

27. County commissioners to give public notice of aggregate value and assessments made, showing the whole amount of taxes assessed on each ward, district and township; and to also give notice of a day for finally determining whether any valuations of assessors have been made below a just rate.

Act July 27, 1842, section 11, (P. L., page 445).*

28. Returns of assessors to be open to inspection of taxables between time of publishing assessments and day fixed for finally determining whether any valuation is too low.

Act July 27, 1842, section 12, (P. L., page 446).

29. Board of revision to ascertain whether returns of assessors have been made in conformity with law; whether property has been valued at a sum it would bring at public sale; to hear and consider communications of taxables informing them that property has been reduced too low; to raise the valuation of property that they believe to have been reduced too low, and may adjourn from day to day.

Act July 27, 1842, section 13, (P. L., page 446).

*See special acts of March 21, 1862, (P. L., page 148), and April 15, 1863 (P. L., page 372), as to Huntingdon and Blair counties.

30. To hear and decide appeals, after notice to taxables, in all cases where valuations have been raised, revised and equalized.

Act July 21, 1842, section 14, (P. L., page 447).

31. Failure of members of board of revision to be sworn, or to discharge the duties of the board, not to invalidate or hinder collection of tax.

Act April 29, 1844, section 47, (P. L., page 502).

32. Appeals may be taken by taxables to court of common pleas, and court to hear and determine the same; but such appeals not to prevent collection of tax. In cases of reduction by order of court, excess to be returned to persons paying the same.

Act April 19, 1889, (P. L., page 37).*

TOWNSHIP RATES.

1. Supervisors authorized to levy a tax not exceeding one cent on the dollar, upon real and personal estate, offices, trades and occupations, for the purpose of laying out, opening, making or repairing roads and highways, and for making and repairing bridges, and for such other purposes as may be authorized by law.

Act April 15, 1834, section 25, (P. L., 1833-34, page 515).

2. Supervisors also authorized to levy a rate and collect the same for the purpose of discharging any just debt due by a former supervisor.

Act February 28, 1835, section 7, (P. L., 1834-35, page 46).

3. In every case in which a rate or assessment shall be laid for township purposes, the same shall be levied upon the basis of the last adjusted valuation made for purposes of regulating county rates and levies.

Act April 15, 1836, section 27, (P. L., 1833-34, page 516).†

4. Supervisors to call to their assistance the township assessor in laying an assessment, who shall furnish them a correct copy of

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*See act April 1, 1836, section 52, (P. L., 1835-36, page 445, and act May 5, 1854, (P. L., page 574), as to appeals in Philadelphia, Bucks and Allegheny counties. See also other special acts as follows: April 3, 1851, section 11, (P. L., page 316), as to Montgomery county; May 5, 1854, (P. L., page 571), as to Allegheny county; April 7, 1862, (P. L., page 301), as to Somerset county; April 26, 1850, section 7, (P. L., page 627), as to Schuylkill county; April 9, 1869, (P. L., page 801), as to Westmoreland county; May 10, 1871, (P. L., page 665), as to Schuylkill, Dauphin, Somerset, Indiana and Cambria counties; March 6, 1872, (P. L., page 215), as to Lancaster county.

†The subject of taxation for county purposes are the same for township purposes.

the last adjusted valuation in the township, and give his aid in making the assessment.

Act April 15, 1834, section 28, (P. L., 1833-34, page 516).

5. Assessments to be entered in a book by supervisors and to be signed by them and deposited with town clerk, if there is one, but if not, then to remain with supervisors; to be subject to inspection of inhabitants and taxables free of charge, and copies to be given on demand made and payment of fees.

Act April 15, 1834, section 29, (P. L., 1833-34, page 516).

6. Supervisors and town clerk liable to a penalty of $3 for refusing to permit inspection of book, or furnish copies.

Act April 15, 1834, section 30, (P. L., 1833-34, page 516).

7. Supervisors to give notice to taxables to work out their road taxes, before issuing duplicate and warrant for collection of tax, and to fix times and places and give opportunity to work out taxes.

Act April 15, 1834, section 34, (P. L., 1833-34, page 516).

8. Duplicates to be made out and warrants issued to collectors to collect tax.

Act April 15, 1834, section 33 (P. L., 1833-34, page 516).

9. Township commissioners, in townships with a population of at least 300 to the square mile, to levy an annual tax for township purposes of not more than one per centum.

Act April 28, 1899, section 7, (P. L., page 107).

10. Duplicate of assessment of tax to be delivered to township treasurer for collection; treasurer to give notice that duplicate is in his hands, and to allow a discount of five per cent. on taxes paid within sixty days.

Act April 28, 1899, section 15, (P. L., page 109).

11. Treasurer to proceed to collect tax from taxpayers at expiration of three months from time of receiving duplicate; may appoint deputies for that purpose, and he and his deputies to have all the power conferred by law on township tax collectors.

Act April 28, 1899, section 16, (P. L., page 110).

12. Any one or more taxpayers of a township or road district may acquire right to make and repair roads and bridges.

Act June 12, 1893, section 1, (P. L., page 451).

13. To petition court of quarter sessions, setting forth willingness and ability to make and repair roads and bridges at their own expense. Supervisors to inspect work, and see that repairs are made.

Act June 12, 1893, section 2, (P. L., page 451).

14. Petitioners to give bond.

Act June 12, 1893, section 3, (P. L., page 452).

15. Notice to be given supervisors of intention to petition court.

Act June 12, 1893, section 4, (P. L., page 452).

16. Court being satisfied with petition and bond, to order contract to be entered into with supervisors. Contractor to provide for work at expense of petitioners, free of cost to township or road district, and to pay township officers for their services.

Act June 12, 1893, section 5, (P. L., page 452).

17. Road taxes not to be levied and collected for year in which contract, as aforesaid, is made.

Act June 12, 1893, section 6, (P. L., page 453).

18. Persons aggrieved by an assessment may appeal to court of quarter sessions, and court to make such order thereon as it shall deem expedient.

Act April 15, 1834, section 36, (P. L., 1833-34, page 517).

19. Collection of tax may be stayed until determination of appeal.

Act April 15, 1834, section 37, (P. L., 1833-34, page 517).

20. Appellant to give bond in an amount equal to the tax charged against him, conditioned for the payment of such sum as the court thinks should be payable.

Act April 15, 1834, section 38, (P. L., 1833-34, page 517).

21. Where there is no township treasurer, supervisors to pay out moneys received by virtue of their offices.

Act April 15, 1834, section 40, (P. L., 1833-34, page 517).

22. Townships and boroughs connected in the assessment of county tax, to make separate assessments, and elect their own assessors and other officers.

Act May 8, 1855, section 10, (P. L., page 511).

23. Where indebtedness of a township or district exceeds limit of tax authorized, or where proper officers refuse to levy tax to pay debt, court of quarter sessions may compel assessment and collection of special tax to pay such debt, by mandamus. If such tax is considered too onerous, court may order same to be levied and collected in yearly instalments.

Act March 31, 1864, (P. L., page 162).

BOROUGH RATES.

1. Boroughs authorized to levy and collect annually for general borough purposes a tax not exceeding one cent on the dollar on the valuation assessed for county purposes; and all property, offices, professions and persons made taxable for county purposes are made taxable for general borough purposes. This not to apply to any borough, the indebtedness of which has been increased by a vote of its citizens, until such indebtedness is paid.

Act June 26, 1895, (P. L., page 346).*

2. Town council to have power to assess, apportion and appropriate such taxes as shall be determined by a majority of them necessary to carry the rules and ordinances of the borough into effect, but in assessing the tax, due regard must be had to the valuation of taxable property taken for the purpose of raising county rates and levies.

Act April 1, 1834, section 8, (P. L., 1833-34, page 166).

3. Town council to constitute a court of appeal, and prior to the collection of tax, inhabitants to be informed of amounts of tax and of time and place of appeal. Court of appeal to have no other powers than to determine the apportionment of the tax and to remedy any grievance that may occur.

Act April 1, 1834, section 13, (P. L., 1833-34, page 167); act April 3, 1851, section 3, (P. L., page 323).

4. Chief burgess to issue his warrant for collection of tax.

Act April 3, 1851, section 7, (P. L., page 324).

5. Tax may be levied on owners of dogs, not to exceed $1 on the owner of one dog, or $2 on the owner of one bitch, and such additional tax as may be deemed proper on the owner of more than one dog or bitch.

Act April 3, 1851, section 2, sub-division XXV, (P. L., page 322).†

6. Dog tax may be appropriated for support and maintenance of public libraries.

Act May 23, 1887, (P. L., page 164).‡

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*In the class of boroughs herein excepted, the tax rate for general borough purposes is limited to one-half cent on the dollar of valuation for county purposes.—Act April 3, 1851, section 2, sub-division XXIV, (P. L., page 322).

†See, under "General Provisions," *post.*, act May 25, 1893, as to taxation of dogs in cities, boroughs and townships.

‡See act May 25, 1893, P. L., page 136), as to taxation of dogs in townships, boroughs and cities.

7. Boroughs authorized to levy a special or additional tax not exceeding eight mills on the dollar of the valuation.

Act April 16, 1875, section 1, (P. L., page 55).*

8. Tax thus raised to be used in erection and maintenance of fire plugs, hydrants, gas lamp posts, and gas or kerosene lamps, for supplying borough with light and water. Act to be accepted by council, and consent of citizens to levy such additional tax to be obtained at special election.

Act April 16, 1875, section 2, (P. L., page 55).

9. May also be used in erection and maintenance of electric lamps and the supply of electric light, and in the purchase of hose for fire engine companies.

Act June 16, 1891, section 1, (P. L., page 302).

10. Boroughs that have heretofore accepted act of April 16, 1875, as aforesaid, may expend funds raised by said tax in supplying themselves with electric light.

Act June 16, 1891, section 2, (P. L., page 303).

11. Boroughs may license theatrical exhibitions, concerts, circuses, shows, mountebanks and jugglers, and other exhibitions within their limits.

Act May 5, 1876, (P. L., page 112).

12. Authorized to change water rates fixed or limited by general or special laws.

Act May 24, 1878, (P. L., page 118).

13. May license auctions.

Act May 7, 1887, (P. L., page 93).

14. Court of quarter sessions may direct by *mandamus*, collection of special tax to pay debts, when tax authorized to be collected is insufficient to pay the same, or when officers refuse to levy additional tax; and such tax may be directed to be collected in one or more annual instalments.

Act April 22, 1887, (P. L., page 61).

15. Special tax to be levied to pay indebtedness of districts annexed or detached from boroughs in cases of changes of borough limits.

Act June 1, 1887, section 1, (P. L., page 285).

16. May license hacks, carriages, omnibuses and other vehicles used for hire.

Act April 22, 1889, (P. L., page 39).

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*An amendment to this section by act of May 1, 1876, (P. L., page 93), was declared unconstitutional in Barrett's Appeal, 116 P. S. R., page 486.

17. May levy a sinking fund tax, to be in addition to other taxes, to redeem bonds issued to pay borough debt.

Act June 24, 1895, section 2, (P. L., page 250).

18. Transient licenses for sale of merchandise to be issued; not to be less than $25 nor more than $200 per month.

Act May 2, 1899, (P. L., page 159).

POOR RATES OR TAX FOR SUPPORT OF POOR.

1. County commissioners to furnish directors or overseers of poor with a correct copy of last adjusted valuation of subjects and things made taxable for county purposes, which said subjects and things are declared to be taxable for support and maintenance of poor.

Act June 8, 1881, (P. L., page 75).

2. Overseers of poor of any township, having first obtained the approbation of any two justices of the peace of a county, empowered to make an assessment not exceeding one cent on the dollar of valuation, as aforesaid. Overseers of poor in boroughs to perform the duties and be subject to the same laws as overseers in townships.

Act April 15, 1834, section 26, (P. L., 1833-34, page 515); act April 3, 1851, section 17, (P. L., page 325.)

3. Overseers of poor also empowered to levy a tax to discharge a just debt by a former overseer.

Act February 28, 1835, section 7, (P. L., 1834-35, page 46).

4. Assessment to be made on last adjusted valuation made for county purposes.

Act April 15, 1834, section 27, (P. L., 1833-34, page 516).

5. Overseers of poor in making an assessment, to call to their assistance the assessor of the township (or borough).

Act April 15, 1834, section 28, (P. L., 1833-34, page 516).

6. Assessments to be entered in a book, and be signed by overseers and lodged with town clerk, if there is one, but if not then to remain with overseers. To be subject to inspection of taxables, and copies to be furnished on payment of fee.

Act April 15, 1834, section 29, (P. L., 1833-34, page 516).

7. Overseers subject to a penalty of $3 for refusing inspection of book or to furnish copies of assessments.

Act April 15, 1834, section 30, (P. L., 1833-34, page 516).

8. To cause duplicates to be made, and to sign the same, and issue their warrant to the collector, authorizing and requiring him to collect tax.

Act April 15, 1834, section 33, (P. L., 1833-34, page 516).

9. Parties aggrieved by assessment may appeal to court of quarter sessions, which is empowered to make such order thereon as deemed expedient.

Act April 15, 1834, section 36, (P. L., 1833-34, page 517).

10. When debt exceeds an amount overseers are authorized to collect in any year or when overseers refuse to levy tax to pay debt, courts may compel the collection of special tax, by mandamus. If the amount of debt is considered too large to pay in one year, court may order tax to be levied and collected in yearly instalments until debt is paid.

Act March 31, 1864, section 1, (P. L., page 162).

11. In counties where there is a house for the support and employment of the poor, poor directors are required to make an estimate of the yearly cost of maintaining said house, and furnish the same to the county commissioners, who are to add the same to their yearly estimate of county expenses before levying county tax.

Act May 8, 1876, section 5, (P. L., page 151).

12. The last preceding assessment for county rates and levies to be the basis of taxation for poor purposes, and county commissioners are authorized to levy a tax not exceeding ten mills for support of poor of county and payment of current expenses. Tax to be levied before third Monday of February, and collected the same as other county tax.

Act June 4, 1879, section 14, (P. L., page 81).

13. Building tax may also be levied, but the same not to exceed one-half the amount levied to pay current expenses.

Act June 4, 1879, section 15, (P. L., page 81).

14. Where poorhouses have been destroyed by fire, tax may be levied to re-build and furnish houses so destroyed .

Act April 10, 1879, section 2, (P. L., page 19).

15. Office of overseer of poor abolished as soon as poorhouses are built and poor removed to same, and outstanding taxes collected and debts paid.

Act May 8, 1876, section 14, (P. L., page 153); act June 4, 1879, section 18, (P. L., page 82).

16. Local laws, under which poorhouses have been erected and are maintained, not repealed.

Act June 4, 1879, section 21, (P. L., page 82); act May 8, 1876, section 16, (P. L., page 153); act March 24, 1877, section 6, (P. L., page 42).

SCHOOL RATES.

1. School directors and controllers of each district to determine, on or before first Monday of May, amount of tax to be levied for

ensuing year, which, with State appropriation, and revenue from other sources, shall be sufficient to keep schools in operation not less than four nor more than ten months.

Act May 8, 1854, section 28, (P. L., page 623).

2. Subjects and things taxable for county purposes, declared to be taxable for school purposes, and to enable school directors to assess and apportion tax, county commissioners are required to furnish them a copy of the last adjusted valuation of subjects and things taxable for county purposes.

Act May 8, 1854, section 29, (P. L., page 624).

3. School directors or controllers to levy and apportion tax on or before first Monday of June; tax not to exceed the amount of State and county tax authorized to be levied on objects, persons and property taxable for county purposes, and all taxes levied in each year to be contained in the same duplicate.

Act May 8, 1854, section 30, (P. L., page 624).

4. Assessors to assess such persons as remove into districts between last assessment and first day of May or who may have been omitted from last assessment, and return their names with amount of tax payable, to school directors, who are to levy and collect tax as in other cases.

Act May 8, 1854, section 35, (P. L., page 625).

5. Warrant for collection of tax, signed by president and countersigned by secretary of school board, to be issued to collector requiring him to collect taxes in the duplicate placed in his hands.

Act May 8, 1854, section 31, (P. L., page 624).

6. Minimum occupation tax to be assessed upon male taxables of the age of twenty-one years.

Act April 11, 1862, section 5, (P. L., page 472).

7. Offices, posts of profit, salaries and emoluments of office, to be taxed at regular rate of school tax of district, upon the whole amount of the valuation, and no more.

Act April 11, 1862, section 6, (P. L., page 472).

8. Tax to be limited to subjects contained in last adjusted valuation for county purposes, certified by county commissioners.

Act May 8, 1855, section 11, (P. L., page 511).

9. Taxables in independent districts to be designated by letters I. D.

Act May 8, 1855, section 3, (P. L., page 509).

10. County commissioners to cause separate assessment to be made in new districts, and furnish copy of same to secretary of district.

Act May 8, 1855, section 7, (P. L., page 510).

11. Boroughs and townships connected in assessment of county tax, to be separated in assessment of school tax.

Act May 8, 1855, section 10, (P. L., page 511).

12. Building tax not to be collected during pendency of proceedings in court for division of township or district, save where necessary to re-build school house accidentally injured or destroyed, or to pay building debt previously contracted.

Act June 13, 1874, (P. L., page 284).

13. Real estate held in trust to be taxable for the benefit of the district within which it is situated.

Act April 11, 1862, section 7, (P. L., page 472).

14. Tax not exceeding one mill may be levied and collected for purchase, improvement and maintenance of a library.

Act June 28, 1895, section 3, (P. L., page 411).

15. In cities of third class, school and building tax to be levied on assessment made for city purposes, and copy of such assessment to be made and certified to school board.

Act May 25, 1897, (P. L., page 85).

16. Special tax, not exceeding amount of regular annual tax, may be levied and is to be applied to purchase of ground, the erection and furnishing of buildings, the payment of a debt contracted in purchasing ground and erecting buildings, completing improvements in school buildings contemplated at the time of their erection, fencing and improving grounds in connection with the erection of buildings, for payment of expenses of fuel used in heating buildings, and for the payment of the expenses of janitor employed to care for school buildings.

Act May 26, 1897, (P. L., page 94).

17. A license of $25 to be paid by transient retailers of merchandise in townships, said license to be for use of the township school fund.

Act May 2, 1899, (P. L., page 159).

COLLECTION OF TAX.*

1. Tax collectors to be elected every three years in boroughs and townships. To give bond annually, to be approved by court.

Act June 6, 1893, (P. L., page 333).

*See "Unseated Lands," *post.*

2. County commissioners empowered to appoint a collector for one or more wards in any city of the third class.

Act April 10, 1899, section 1, (P. L., page 34).

3. Such collector can collect tax in any ward whether a resident of the same or not, but he must be a resident of the city for which he is appointed.

Act April 10, 1899, section 2, (P. L., page 34).

4. Duplicates of city tax, when completed, in cities of the third class, to be placed in hands of city treasurer on or before June first, who is to receive and collect the same. To add three per cent. to delinquent tax on September 1st, and one per cent. monthly thereafter on delinquent taxes until paid.

Act May 23, 1889 ,Article XV, section 7, (P. L., page 7).*

5. City treasurer, in cities of third class, to be school treasurer. To give bond, subject to approval of board of controllers, and additional security may be required when school funds are endangered, and in case of default in giving such additional security another treasurer may be elected.

Act May 23, 1889, section 4, (P. L., page 275).

6. School tax in such cities to be collected the same as city tax, and collectors of city taxes to be collector of school taxes.

Act May 23, 1889, section 5, (P. L., page 275).†

7. Courts of quarter sessions and county commissioners empowered to fill vacancies in office of tax collector.

Act June 25, 1885, section 2, (P. L., page 187); act July 2, 1895, section 1, (P. L., page 434); act April 15, 1834, section 18, (P. L., 1833-34, page 514).

8. Term of office of collector, in boroughs and townships, to commence on first Monday of April after his election.

Act June 25, 1885, section 1, (P. L., page 187).

9. On failure to give bond and qualify, on or before fourth day of term of quarter sessions next ensuing his election, court to declare office vacant.

Act June 25, 1885, section 2, (P. L., page 187).

10. To be sworn and give bond.

Act June 6, 1893, (P. L., page 333); act June 25, 1885, section 3, (P. L., page 187); act April 15, 1834, sections 19 and 43, (P. L., 1833-34, page 514 and 518).

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*See act February 27, 1860, (P. L., page 85); act May 1, 1861, (P. L., page 667); act April 14, 1863, (P. L., page 434). and act March 29, 1872, P. L., page 642), as to Allegheny City.

†See act February 27, 1860, (P. L., page 85); act May 1, 1861, (P. L., page 667); act April 14, 1863, (P. L., page 434), and act March 29, 1872, (P. L., page 642), as to Allegheny City

11. Authorities empowered to levy taxes in boroughs and townships, to issue, on or before August 1st, duplicates, with their warrants attached, authorizing and directing collection of tax. Road tax may be worked out, but when lawful and necessary to collect the same in money, such collection may be made by collector, or supervisors or road commissioners, but when collected by collector he is to receive as compensation five per cent. of the amount collected by him.

Act June 25, 1885, section 4, (P. L., page 187).

12. County commissioners to issue warrants, with duplicates attached, for collection of State and county tax in other places.

Act April 15, 1834, section 20, (P. L., 1833-34, page 514).

13. Collectors in boroughs and townships to have same powers, in collection of taxes, heretofore vested in collectors of county tax, and be subject to same liabilities and penalties for neglect or violation of duties of office.

Act June 25, 1885, section 5, (P. L., page 188).

14. Collectors in boroughs and townships to provide book, with list of taxables and amount of taxes charged. Book to be open to inspection and delivered to successors in office.

Act June 25, 1885, section 6, (P. L., page 188).

15. Collectors in boroughs and townships to give notice by handbills that duplicates have been issued to them; and persons making payment within sixty days, entitled to an abatement of five per cent. Five per cent. additional to be charged against persons delinquent for six months or more.

Act June 25, 1885, section 7, (P. L., page 188).

16. Collectors in boroughs and townships to attend in person or by deputy, at place fixed by them, on Thursday, Friday and Saturday of each week of the last two weeks of the sixty days designated for receiving taxes, to receive and receipt for taxes.

Act June 25, 1885, section 8, (P. L., page 188).

17. Collectors in consolidated boroughs, to continue in office until terms of office expire, and thereafter one collector to be elected, who shall give bond, collect taxes, and have powers of collectors under general laws.

Act June 6, 1893, section 12, (P. L., page 339).

18. Collectors in boroughs and townships entitled to a commission of two per cent. on all taxes on which an abatement of five per cent. is allowed, and five per cent. on all taxes afterwards collected; but where total amount of taxes charged in a duplicate is less than

$1,000, collectors to receive three per cent. on all taxes on which an abatement of five per cent. is allowed. A full settlement to be made by collectors not later than three months after expiration of terms of office.

Act June 2, 1891, (P. L., page 175).

19. Collectors of State and county tax in other places to receive as compensation five per cent. on all moneys collected.

Act April 15, 1834, section 52, (P. L., 1833-34, page 519)*

20. All tax collectors to make monthly returns, and to pay over, monthly moneys collected as taxes, less their commissions. To file duplicate returns with borough councils, and take duplicate receipts from borough treasurer for payments made.

Act July 9, 1897, section 1, (P. L., page 242).

Failure to comply with aforesaid provision, to be punishable by fine not exceeding $100.

Act July 25, 1897, section 2, (P. L., page 243).

21. Exonerations may be made of taxes assessed in boroughs and townships, as heretofore.

Act June 25, 1885, section 10, (P. L., page 189).

22. Accounts to be settled by borough and township auditors, and a separate account to be stated for each different tax collected. Collectors of State and county taxes to settle with county commissioners.

Act June 25, 1885, section 11, (P. L., page 189).

23. Taxes charged on unseated lands to be certified to county commissioners to be collected as heretofore.

Act June 25, 1885, section 12, (P. L., page 189).

24. Act not to apply to taxes, the collection of which is regulated by local laws.

Act June 25, 1885, section 13, (P. L., page 189).†

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*See act of April 10, 1862, (P. L., page 377), as to Delaware county, applicable to Chester city.

†See local laws as follows: Allegheny county, 1861, page 450, and 1866, page 390; Armstrong county, 1873, page 357; Bedford county, 1868, page 1017; Bucks county, 1859, page 294, 1864, page 177, 1867, page 201, 1868, page 588, and 1873, page 604; Cambria county, 1872, page 994, and 1899, page 111; Carbon county, 1866, page 966; Chester county, 1868, page 595, 1869, page 553, and 1872, page 820; Clarion county, 1854, page 171, and 1865, page 511; Cumberland county, 1867, page 836, and 1873, page 661; Franklin county, 1853, page 128; Fulton county, 1864, page 373; Greene county, 1855, page 528, 1857, page 163, and 1869, page 808; Huntingdon county, 1872, page 179; Indiana county, 1872, page 954, and 1873, page 472; Jefferson county, 1857, page 53, and 1871, page

25. On failure to pay tax within thirty days after demand made, collectors to levy amount by distress and sale of goods and chattels of delinquents, and in case property sufficient to pay tax cannot be found, delinquents may be sent to jail.

Act April 15, 1834, section 21, (P. L., 1833-34, page 514).

26. Warrant for collection of tax to be effectual for two years.

Act April 22, 1846, section 21, (P. L., page 490).

27. Females, infants and persons of unsound mind not to be arrested or imprisoned for non-payment of tax.

Act April 15, 1834, section 45, (P. L., 1833-34, page 518).

28. Goods and chattels of persons occupying real estate, liable to distress and sale for non-payment of taxes assessed against such real estate, the same as if they were the owners of the real estate.

Act April 15, 1834, section 46, (P. L., 1833-34, page 518).

29. Courts may require collectors of special taxes to give bond, and in case of failure to do so they may appoint collectors of such tax.

Act May 25, 1878, (P. L., page 150).

30. Collectors prohibited from suing for taxes during time warrant is effective.

Act April 15, 1834, section 50, (P. L., 1833-34, page 519).

31. May sue for taxes after expiration of warrant.

Act April 11, 1848, section 3, (P. L., page 524).

32. Executors and administrators of deceased collectors, authorized to collect unpaid taxes.

Act March 26, 1867, section 1, (P. L., page 45).

33. May employ persons to act for them.

Act March 26, 1867, section 2, (P. L., page 46).

34. Collectors may appoint deputies, with approbation of county or township treasurer.

Act April 15, 1834, section 51, (P. L., 1833-34, page 519).

35. State, county and poor taxes placed in hands of collectors, to be credited to county treasurer, if previously charged to him, and charged to collectors; collectors to give bond and make monthly returns.

Act June 8, 1891, (P. L., page 212).

1079; Lawrence county, 1859, page 13, 1861, page 81, and 1873, page 717; Luzerne county, 1866, page 966; Monroe county, 1867, page 1322; Montgomery county, 1860, page 665, 1868, page 342, 1871, page 659, and 1872, page 279; Union county, 1872, page 1055; Washington county, 1855, page 528, and 1857, page 163. See also act March 14, 1860, (P. L., page 166), as to Westmoreland, Fayette, Adams and York counties, and act April 8, 1862, (P. L., page 339), as to Luzerne county.

36. Collectors of State and county tax to make returns under oath.

Act April 22, 1846, section 19, (P. L., page 490).

37. County commissioners to file with prothonotary certificate of amount of taxes due by a collector; and such certificate to be entered on docket, and to have the effect of a judgment, and execution may be issued thereon.

Act February 28, 1835, section 3, (P. L., 1834-35, page 46).

38. Clerk to county commissioners to enter names of collectors and amount of duplicates on minutes of their office, and furnish copy to county treasurer.

Act February 28, 1835, section 4, (P. L., 1834-35, page 46).

39. Collectors in boroughs and townships to furnish numbered receipts for payment of tax in book provided by county commissioners, containing stub. Memoranda corresponding with receipts to be made on stub.

Act June 25, 1895, section 1, (P. L., page 296).

40. Sheet, containing numbers of receipts, dates of payment, names of the taxpayers, amount of tax, and district in which taxpayers are assessed, to be sent county commissioners twenty days before election.

Act June 25, 1895, section 2, (P. L., page 296).

41. Sheets to be bound, and kept for public inspection.

Act June 25, 1895, section 3, (P. L., page 296).

42. Violation of act punished by a fine not exceeding $200 and imprisonment not exceeding one year, either or both, at discretion of court.

Act June 25, 1895, section 4, (P. L., page 296).

43. Road or poor taxes in townships and boroughs may be collected by levy and sale, the same as school and county taxes are collected.

Act May 22, 1895, (P. L., page 111).

44. In townships having a population of at least three hundred to the square mile, tax levied by township commissioners to be collected by township treasurer, who is required to give notice of the placing of the duplicate in his hands, and to allow a discount of five per centum on all taxes paid within sixty days. After three months, tax to be collected by him or his deputies, as now collected by township tax collectors.

Act April 28, 1899, sections 15 and 16, (P. L., page 110).

45. Township treasurer in such townships to give bond, take charge of township moneys, and have his accounts audited annually by township auditors.

Act April 28, 1899, section 13, (P. L., page 109).

46. Payment of occupation or poll tax for others prohibited, except on written order signed by the electors authorizing the same, thirty or more days prior to an election.

Act July 15, 1897, section 1, (P. L., page 276).

47. Collectors prohibited from receiving or receipting for occupation or poll tax except from electors themselves, or on their written and signed order authorizing payment of tax.

Act July 15, 1897, section 2, (P. L., page 276).

48. Unlawful to note on receipt obtained in violation of act.

Act July 15, 1897, section 3, (P. L., page 276).

49. Violation of act punishable by fine not exceeding $200, or imprisonment not less than twenty days nor more than six months.

Act July 15, 1897, (P. L., page 276).

50. Collectors failing to perform duties, subject to a penalty of $50.

Act April 22, 1846, section 20, (P. L., page 490).

51. No person to be re-appointed collector of county tax until amounts received on former duplicates are finally settled and paid over.

Act April 15, 1834, section 42 (P. L., 1833-34, page 518); act February 28, 1835, section 5, (P. L., 1834-35, page 46).

52. Abatements and exonerations to be made for mistakes, indigent persons, unseated lands, etc.

Act April 15, 1834, section 48, (P. L., 1833-34, page 518).

53. Receipts not to be given for unassessed or exonerated taxes, nor shall such taxes be received, unless persons exonerated voluntarily appear and tender payment; and names not to be added to lists of taxables returned by assessors. Penalty for violating section is a fine of $100 and removal from office.

Act May 27, 1841, section 8, (P. L., page 402).

54. Conversion, misappropriation and failure to pay over taxes by tax collectors, to be deemed embezzlement. Persons offending, and their accessories, liable to a fine not exceeding $500 and imprisonment not exceeding five years, either or both.

Act June 3, 1885, (P. L., page 72).

55. County treasurer to issue warrant to sheriff to take body and seize effects of defaulting collectors.

Act April 11, 1799, section 18, (3d Smith's Laws, page 399).

56. County commissioners to issue warrant to sheriff to sell property of defaulting collectors seized by him.
Act April 11, 1799, section 19, (3d Smith's Laws, page 399).

57. Sheriff to execute deed for real estate of defaulting collectors seized and sold by him.
Act April 11, 1799, section 20, (3d Smith's Laws, page 399).

58. Sheriff's failing to pay over moneys received for taxes, to be proceeded against.
Act April 11, 1799, section 21, (3d Smith's Laws, page 399).

59. Collectors to return to county commissioners lands upon which sufficient personal property cannot be found to pay tax, in all cases where owners fail to pay the tax; and said lands to be sold the same as unseated lands for non-payment of taxes. No sale to be made until taxes are delinquent for two years.
Act April 29, 1844, section 41, (P. L., page 501).*

60. Owners may redeem real estate sold for taxes in the same manner as if the same were unseated, and assessed and sold as unseated.
Act May 13, 1879, section 1, (P. L., page 55).

61. Owners may show that there was sufficient personal property on real estate sold to pay taxes, which might have been seized by collectors, and in such cases their title not to be doubted.
Act May 13, 1879, section 2, (P. L., page 55).

62. Notice to be given of sales of land for taxes.
Act March 22, 1850, section 7, (P. L., page 306).

63. County commissioners to purchase for use of county lands on which bids are insufficient to pay arrearages of tax; to keep record of the same, and charge taxes against it for five years, but not to be placed on tax collectors' duplicates.
Act July 8, 1885, section 1, (P. L., page 268).

64. Rates of taxation for local purposes to be certified to county commissioners, and charged against said lands.
Act July 8, 1885, section 2, (P. L., page 268).

65. Right of redemption to remain in owners for five years, and to be conveyed to them, on payment of taxes, interest and costs.

*See act April 5, 1842, section 6, (P. L., page 242), as to Dauphin county; act March 6, 1868, section 2, (P. L., page 275), as to Lycoming county; act February 16, 1867, (P. L., page 214), as to Potter, Warren, Bradford and Sullivan counties; act February 18, 1870, (P. L., page 174), as to Elk county; act March 12, 1869, (P. L., page 340), as to Potter county; act April 15, 1869, (P. L., page 1937), as to Tioga county.

Moneys received to be paid to townships and districts entitled to receive the same.

Act July 8, 1885, section 3, (P. L., page 268).

66. Right of redemption having passed, lands may be sold by county commissioners at public sale, and to be assessed against purchasers.

Act July 8, 1885, section 4, (P. L., page 269).

67. Tenants liable for road tax, and may deduct same from rent due, and sue and recover same from owner.

Act April 6, 1802, section 8, (3d Smith's Laws, page 516).

68. Liable for all taxes on lands they occupy; and may either deduct same from rent or recover them from owners.

Act April 3, 1804, section 6, (4th Smith's Laws, page 201).

GENERAL PROVISIONS.

1. Where township lines divide a tract of land, the assessment it to be made in the township in which the mansion house is situated, but this is not applicable where mansion house is in an incorporated city or borough.

Act July 11, 1842, section 59, (P. L., page 331); act April 25, 1850, section 15, (P. L., page 572).

2. When line dividing a township and a borough, or two townships, passes through mansion house on farm land, owner may choose place of residence of occupants of said house; but if this is not done, occupants to be regarded as wholly within the township, and to be assessed accordingly.

Act May 24, 1878, (P. L., page 131).

3. When county lines divide a tract of land, and when lines separate a borough from a township or one borough from another, assessment to be made where mansion house is situated.

Act June 1, 1883, (P. L., page 51); act May 23, 1871, (P. L., page 1067).

4. Estates of decedents may be taxed in names of decedents, or their respective executors, administrators or heirs. Tax to be a lien for one year from first day of June following the assessment, and may be collected from persons in possession. Expiration of lien not to prevent collection within the time provided in other cases. Not to repeal other laws fixing a different time for existence of liens.

Act April 22, 1846, section 23, (P. L., page 491).

5. Persons transplanting on their own premises, on side of public highways, fruit, shade or forest trees, of suitable size, to be allowed

where roads run through or adjoin cultivated fields, in abatement of road tax, $1 for every four trees set out; rows of elms to be seventy or more feet apart; rows of maple or other forest trees, except locust, to be fifty or more feet apart, and rows of locust to be thirty or more feet apart. Trees to be set out the year before demand for abatement is made, and to be living and well and protected from animals at time demand for abatement is made.

Act May 2, 1879, section 1, (P. L., page 47).

6. Credit to be allowed for trees transplanted in place of ones dying.

Act May 2, 1879, section 2, (P. L., page 47).

7. No abatement to be allowed in excess of one-fourth of highway tax.

Act May 2, 1879, section 3, (P. L., page 47).

8. Persons cutting down, killing or injuring such trees, liable to a penalty of fifty cents for every tree cut down, killed or injured, to be collected as road taxes are collected and paid to supervisors.

Act May 2, 1879, section 4, (P. L., page 47).

9. Owners of tracts of uncleared land containing not less than fifty trees to the acre, and each tree measuring eight or more inches in diameter at a height of six feet above the surface, to receive from county commissioners, during the time the trees are maintained in sound condition, a sum equal to eighty per cent. of taxes annually assessed and paid on said land; but the amount paid is not to exceed forty-five cents per acre, and no one owner to receive payment on more than fifty acres.

Act May 25, 1897, (P. L., page 88).

10. Rebate of one-fourth of highway tax to be allowed to persons owning and using on public highways draft wagons, with tires not less than four inches wide, for hauling loads of not less than two thousand pounds weight; said rebate not to exceed five days' labor on highways or its equivalent in cash to any one person.

Act June 25, 1895, section 1, (P. L., page 288).

11. Persons complying with act to make proof before supervisor, on oath.

Act June 25, 1895, section 2, (P. L., page 288).

12. Supervisors and road commissioners to contract annually on first Monday of April for removal of loose stones by tax-payers from main highways during April, May, June, July, August, September and October.

Act May 2, 1899, section 1, (P. L., page 164).

13. Authority may be delegated to pathmaster, and compensation for work done to be credited on road tax.

Act May 2, 1899, section 2, (P. L., page 164).

14. Supervisors, road commissioners or other officers having charge of the construction or repair of township roads, authorized to collect a cash tax not exceeding fifty per centum of rate of assessment for road purposes, for purchase of a lot and erection of a building for general township purposes, and for re-payment of moneys borrowed for that purpose.

Act June 26, 1895, section 3, (P. L., page 325).

15. Appeals may be taken from assessments to courts of common pleas.

Act April 19, 1889, (P. L., page 37), *ante*.

16. County commissioners in counties where county treasurer collects taxes, empowered, on petition of five hundred or more taxables, to change dates on which reductions for prompt payment of taxes shall cease.

Act June 30, 1885, section 1, (P. L., page 204).

17. To give notice, on or before July first, to county treasurer of changes made, and any change so made to continue from year to year until again changed.

Act June 30, 1885, section 2, (P. L., page 204).

18. Cities, boroughs and townships empowered to tax dogs. Tax to be fixed by county commissioners and councilmen at not more than $2 for a dog, or more than $4 for a bitch unless she is spayed, in which case the tax is to be the same as a dog. Tax to be paid to county or city treasurer, and to constitute a fund for payment of sheep damages. Dogs under four months old not to be assessed.

Act May 25, 1893, section 1, (P. L., page 136).*

19. Assessors to return names of persons owning or keeping dogs, and county commissioners and councilmen to assess a tax sufficient to pay damages sustained from loss of sheep.

Act May 25, 1893, section 2, (P. L., page 136).

20. Persons sustaining damages from loss of sheep may complain to justices of the peace, aldermen or magistrates. Township, borough or city auditors or controllers to be notified; they to examine into claim and make report. Owners of dogs destroying sheep, to pay claims for damages, or kill their dogs.

Act May 25, 1893, section 3, (P. L., page 137).

21. Where damages are sustained, report to be delivered to county commissioners or councilmen.

Act May 25, 1893, section 4, (P. L., page 137).

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*See act June 12, 1878, (P. L., page 198); act June 10, 1881, (P. L., page 112); act May 5, 1889, (P. L., page 222).

22. Warrant to be drawn on county or city treasurer for amount of claim, to be paid out of sheep damage fund, but effort must be made to ascertain whose dog did the damage.

Act May 25, 1893, section 5, (P. L., page 136).

23. County commissioners or councilmen to notify owners of dogs that destroyed sheep, to kill them, and on failure to do so constable or police to kill them, and for this service he is to receive a fee of $1, to be paid out of sheep damage fund.

Act May 25, 1893, section 6, (P. L., page 138).

24. Dogs declared to be personal property and made the subject of larceny, and owners liable for all damages done to sheep.

Act May 25, 1893, section 7, (P. L., page 138).

25. Justices of the peace, aldermen and magistrates entitled to a fee of $1 in each case, and auditors and controllers to receive $1 per day for every day spent in investigating claims.

Act May 25, 1893, (P. L., page 139).

26. A fund in excess of $200 at the close of the year, to be paid into county or city fund to be used for county or city purposes.

Act May 25, 1893, section 9, (P. L., page 139).

27. Special laws not repealed.

Act May 25, 1893, section 10, (P. L., page 139).

28. Municipalities increasing their indebtedness, to levy an annual tax before issuing obligations.

Act April 18, 1895, section 1, (P. L., page 37).

29. Tax to be sufficient to pay the interest and redeem the principal of the obligations not later than thirty years from date of increase of indebtedness.

Act April 18, 1895, (P. L., page 37), act May 11, 1897, (P. L., page 54).

30. County commissioners issuing bonds to erect workhouses, authorized to levy special tax of one mill on the assessed valuation for county purposes, to pay interest and redeem principal of bonds so issued.

Act June 26, 1895, section 15, (P. L., page 381).

31. County commissioners authorized to transfer into general county fund, tax moneys placed to credit of any city, borough or township, that have remained uncalled for during a period of ten years, provided right to money is not in dispute.

Act July 15, 1897, (P. L., page 285).

32. County commissioners to give notice in not more than five nor less than two newspapers of intended sales of real estate purchased by them for non-payment of taxes.

Act July 2, 1895, (P. L., page 421).

33. Surplus bonds given by purchasers at tax sales, to be acknowledged, and deposited with county treasurer before deed is given. Bonds to be recorded by prothonotary in a book provided for that purpose, and to be filed in his office.

Act May 8, 1861, section 1, (P. L., page 47).

34. Prothonotary entitled to a fee of fifty cents on each bond. To give certified copies of bonds, to be received in evidence same as original bond.

Act May 8, 1895, section 2, (P. L., page 47).

35. Transient retailers of merchandise in cities, boroughs and townships, to be licensed. Such license in cities and boroughs not to be less than $25 per month, nor more than $200 per month. In townships the license to be $25 per month, for use of school fund of township. Failure to be licensed, to be punished by a fine not less than $100 nor more than $200, and on failure to pay same, person offending to be imprisoned, not exceeding thirty days.

Act May 2, 1899, (P. L., page 159).

36. Taxes to be first liens on real estate, except in cities of first and second class. To be returned to county commissioners, where they cannot be collected from owners or tenants, and recorded in tax lien record. Returns to contain full statement of delinquents, kind and amount of tax due, description of properties against which assessed, also, that sufficient personal property to pay tax could not be found; and to be signed and verified by oaths of persons making returns. To be a lien when recorded. Record to be notice to all persons, and certified copy to be evidence. Record to be satisfied on payment of taxes.

Act June 2, 1881, section 1, (P. L., page 45).—Altered, *post.**

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*See act April 5, 1844, (P. L., page 199), as to Allegheny county; act March 15, 1847, section 2, (P. L., page 366), as to Lancaster; act April 10, 1848, (P. L., page 348), as to Harrisburg; act April 10, 1848, section 1, (P. L., page 435), as to Columbia borough; act April 11, 1850, section 5, (P. L., page 453), as to Centre county; act February 27, 1860, section 2, (P. L., page 85), as to Allegheny City; act April 4, 1870, section 11, (P. L., page 866), as to Lycoming county; act April 1, 1873, (P. L., page 509), as to Delaware county; see also section 1, act May 4, 1889; sections 1 and 2, act May 22, 1895; act June 4, 1897, and sections 1 and 2, act of April 28, 1899, *post.*

37. Taxes to be first paid out of the proceeds of judicial sales, after payment of costs. Sales, except for collection of taxes, not to affect liens of first mortgages. Taxes paid by lien holders may be recovered with interest, by producing receipt of county treasurer, to be entered on record of lien of judgment or mortgage, or added to claim for purchase money.

Act June 2, 1881, section 2, (P. L., page 46). Altered.: See section 1, act May 4, 1889, sections 1 and 2, act May 22, 1895, act June 4, 1897, and sections 1 and 2, act April 28, 1899, *post*.

38. Collectors wilfully returning to county commissioners taxes that might, with proper diligence, have been collected, to be liable to persons injured thereby. Act not to repeal local or special laws.

Act June 2, 1881, section 3, (P. L., page 46).

39. County, city, borough, township and school taxes not to be liens until entered of record in prothonotary's office. Tax liens and liens for municipal improvements, to be revived within five years, to continue the lien.

Act May 4, 1889, section 1, (P. L., page 79). Altered, see sections 1 and 2, act May 22, 1895, act June 4, 1897, and sections 1 and 2, act April 28, 1899, *post*.

40. Lien of taxes to be divested by judicial sale, provided amount of purchase money equals amount of taxes.

Act May 22, 1895, section 1, (P. L., page 111).

41. Tax collectors and county commissioners to give notice to persons selling property of amount of taxes against the same, if said taxes have not been certified for collection; and persons selling property to pay taxes out of proceeds of sale.

Act May 22, 1895, section 2, (P. L., page 111).*

42. County, city, borough, township and school tax not to be a lien on real estate for a longer period than three years from first day of January next succeeding year in which due, unless entered of record in prothonotary's office. Tax liens and municipal claims entered of record, not to be liens for more than five years unless revived by *scire facias* within that time. Liens entered of record prior to May 4, 1889, not to remain liens longer than three years unless revived within said three years.

Act June 4, 1897, (P. L., page 123).

43. Prothonotaries to make up dockets of unsatisfied county, poor, road, school, borough and township tax liens. Such dockets, on

*See case of Taylor vs. Bowling, 5th Superior Court Reports, page 225.

completion, to be evidence and notice of unsatisfied liens, but original dockets not to be notice or evidence.

Act April 28, 1899, section 1, (P. L., page 120.)

44. Prothonotaries to enter in separate dockets, in alphabetical order, all unpaid county, poor, road, school, school building, borough and township tax; and dockets to be notice to all persons. Tax liens not to be entered upon general judgment index.

Act April 28, 1899, section 2, (P. L., page 120).

45. County commissioners may sue out writ of estrepement to prevent the cutting or removal of timber or the peeling of bark on lands returned to them for non-payment of tax, and such writ to continue in force until tax is paid.

Act May 4, 1889, (P. L., page 83).†

46. County auditors to settle accounts of county commissioners, county treasurer and directors of the poor.

Act April 15, 1834, sections 48 and 49, (P. L., 1833-34, page 545); act June 2, 1881, section 1, (P. L., page 44).

47. Report to be filed with prothonotary, and to have the effect of a judgment.

Act April 15, 1834, section 55, (P. L., 1833-34, page 547).

48. Appeals therefrom authorized, and court may direct an issue to be tried by a jury.

Act April 15, 1834, section 56, (P. L., 1833-34, page 547); act April 14, 1838, section 16, (P. L., 1837-38, page 460).

49. Execution may issue against defaulting officers.

Act April 15, 1834, section 58, (P. L., page 547).

50. Auditors of townships and boroughs to meet annually, on the second Monday of April, and audit, settle and adjust accounts of supervisors, road commissioners, borough and township treasurers, and such other township officers as may by law be referred to them.

Act April 24, 1874, section 1, (P. L., page 112); act March 31, 1876, (P. L., page 12); act April 15, 1834, section 102, (P. L., 1833-34, page 555).

51. To post hand-bills containing itemized statement of receipts and expenditures of borough councils, road commissioners, supervisors, overseers of the poor and school directors; and to file copy of statement with town clerk and clerk of court of quarter sessions, to be subject to inspection by citizens. Act not to interfere with laws requiring publication in newspapers.

Act April 24, 1874, section 2, (P. L., page 112).

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†See act April 8, 1862, (P. L., page 317), as to Jefferson and Potter counties.

52. Auditors failing to comply with act, to be subject to a penalty of $20.

Act April 24, 1874, section 3, (P. L., page 113).

53. Boards of school directors to place in hands of auditors, at close of school year, itemized statement of receipts and expenditures, with books, papers and vouchers, and statement of assets and liabilities. To be examined and approved by auditors if found correct, then spread upon minutes of board, and published by hand-bills or in two newspapers having largest circulation among citizens interested. Failure to perform duties to be punished by a fine not exceeding $300.

Act May 1, 1876, (P. L., page 91).

54. Any taxpayer may appeal from report of auditors to court, in behalf of borough, township, ward or district.

Act May 1, 1876, (P. L., page 88).

55. Accounts of poor districts composed of part of cities, boroughs and townships of a county, to be audited on second Monday of January by a board composed of the senior auditors of each city, borough and township of which the district is composed. Auditors to receive $1.50 per day for their services.

Act June 8, 1881, section 1, (P. L., page 85). This act not to repeal special laws. Act June 8, 1881, section 2, (P. L., page 85).

56. In Allegheny county, controller audits county accounts and accounts for State tax.

Act May 1, 1861, (P. L., page 450).

57. In counties containing over one hundred and fifty thousand inhabitants, controller to be elected, and to audit all county accounts and State taxes for which county is liable. Other accounts of county treasurer with Commonwealth to be audited by auditor appointed by court of common pleas, under act of April 21, 1846, and supplements thereto.

Act June 8, 1893, (P. L., page 393).

58. Counties, cities, boroughs and townships receive revenue from retail liquor licenses granted by courts of quarter sessions. The amount of such license in cities of the first and second class is $1,000; in cities of the third class, $500; in other cities, $300; in boroughs, $150, and in townships, $75. Said amounts are to be paid to the county treasurer and distributed by him as follows: To counties, $100 on each license granted in all cities they contain, and the balance to the cities for their own use; and in boroughs and townships, one-fifth of the amount of each license is given the county, and the balance the proper borough or township. Moneys thus paid

into a township treasury to be used in keeping the roads in good repair.

Act June 9, 1891, (P. L., page 348).

59. In counties containing over one hundred and fifty thousand inhabitants, county officers to be paid by salary, and all fees received by them are to be paid into county treasury for use of the county.

Act March 31, 1876, (P. L., page 13).

UNSEATED LANDS.*

1. Unseated lands to be valued and assessed in the same manner as other property.

Act April 3, 1804, section 2, (P. L., 1803-04, page 519).†

2. County surveyors, on application of county commissioners, to make returns of unseated lands, containing number of acres in each survey or warrant, original warrantee names, and full description of land, and to receive from county treasury four cents for each warrant or survey returned by them. To be subject to a penalty of $100 for failure to make return. County commissioners to enter in a book the number of acres surveyed, and names of original owner and boundaries of each tract returned, as aforesaid.

Act April 3, 1804, section 1, (P. L., 1803-04, page 518).

3. Holders of unseated lands to furnish county commissioners descriptions of tracts held by them, also original warrantee names, and the nature, number and date of original title, together with date of conveyance to them and names of granters, within one year after conveyance made to them; and for failure to furnish this statement, quadruple tax to be assessed on lands.

Act March 28, 1806, (P. L., 1805-06, page 644).

4. Assessment of road tax on unseated lands, returned by assessors in mistake as seated lands, to be deemed valid.

Act April 12, 1842, section 21, (P. L., page 266).

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*See "Collection of Tax," *ante*.

†See act of March 30, 1831, section 30, (P. L., 1830-31), as to appeals from assessments of unseated lands in Crawford, Erie, Warren and Venango counties, and acts of March 15, 1832, (P. L., 1831-32, page 153), and January 25, 1872, (P. L., page 65), as to Huntingdon, Pike and Wayne counties; act May 3, 1852, section 6, (P. L., page 522), as to Centre county.

5. Returns for collection of taxes on unseated lands to be made on or before the first day of February in each year, and if not so made such returns not to be thereafter received and the taxes not to be liens on real estate; but this section is not to be so construed as to exempt assessors and collectors, and their bail, from liability for not making their returns according to law.

Act April 21, 1856, section 2, (P. L., page 477); act February 23, 1858, (P. L., page 45.)

6. Supervisors and collectors of road and other taxes to make returns of exonerations claimed on or before the first day of February in each year; and county commissioners not to grant any exonerations after that time, and the county treasurer not to sell any lands returned and the taxes exonerated after that time.

Act April 21, 1856, section 3, (P. L., page 477); act February 23, 1858, (P. L., page 45).

7. Unseated lands to be assessed for poor tax in the same manner as other real estate, and when not voluntarily paid, the collector or overseer of the poor of the proper district, to certify the same to the county commissioners, as in the case of road and school tax; and county commissioners to enforce collection with taxes assessed for county purposes, and when collected to be paid to overseers of poor of the proper district by orders drawn by county commissioners on county treasurer.

Act May 14, 1874, (P. L., page 155).*

8. Taxes charged upon unseated lands not to be collected by borough and township collectors, but to be certified and returned by authorities levying the tax to county commissioners, to be collected as heretofore.

Act June 25, 1885, section 12, (P. L., page 189).

9. All taxes levied upon unseated lands to be paid by owners within the year for which levied, and in case of failure to do so, six per cent. interest to be charged from first day of the year following that for which tax is levied until tax is paid or land sold for taxes.

Act June 6, 1887, (P. L., page 363).

10. County commissioners may direct county treasurer to receive in advance for a term not exceeding six years a sum which in their estimation, will be equal to the taxes that ought to be imposed upon the land during said time.

Act March 13, 1815, section 8, (P. L., 1814-15, page 180).

*See act January 30, 1862, (P. L., page 8), as to Columbia county.

11. Tenants occupying or possessing lands, to be liable for payment of taxes becoming due during occupancy or possession; and may recover the amount of the same from the landlord or defalcate the amount in the payment of rent due, unless any contract or agreement previously made would be impaired thereby.

Act April 3, 1804, section 6, (P. L., 1803-04, page 522).

12. Joint owners may pay their proportionate share of tax, and county treasurer to receive and receipt for the same; and he may sell the residue of shares or interest in the lands on which taxes are due.

Act April 25, 1850, section 31, (P. L., page 574).

13. Receipts for taxes on unseated lands, acknowledged before a judge or justice of the peace, may be recorded in county where lands lie, and the records thereof or certified copies of the same, to be evidence in all cases in which original receipts would be evidence.

Act March 9, 1847, section 1, (P. L., page 279).

14. Judge or justice of the peace to take acknowledgments of receipts, at cost of parties applying for same, on being required so to do, but applications for acknowledgments to be made within thirty days from date of receipts.

Act March 9, 1847, section 2, (P. L., page 279).

15. County treasurers to enter payments of taxes on unseated lands made to them in book kept for that purpose, and to give certified copy, under official seal, of entries in book showing payment of tax, at request of person paying the same; and each treasurer to receive twenty-five cents from the person demanding receipt or certified copy.

Act April 30, 1879, section 1, (P. L., page 34).

16. County commissioners to procure and furnish county treasurers with book and seal, and all payments of taxes on unseated lands to be entered in said book.

Act April 30, 1879, section 2, (P. L., page 35).

17. County treasurers to commence sales of unseated lands for taxes on second Monday of June, and may adjourn from day to day; and to make sale of tracts as a whole or in part, sufficient to pay arrearages of tax and costs, and to execute deeds; and to give sixty days' notice of time and place of sale in two newspapers, if so many are published in the county where the lands lie, but if not then in one newspaper in or nearest to the county where the lands lie, under

penalty of $50, but neglect to make publication not to invalidate sales.

Act March 13, 1815, section 1, (P. L., 1814-15, page 177); act March 29, 1824, section 5, (P. L., 1823-24, page 168); act March 9, 1847, sections 1 and 2, (P. L., page 278).*

18. Duties formerly enjoined on sheriffs, with reference to sales of unseated lands for taxes, to be performed by county treasurers.

Act April 4, 1809, section 1, (P. L., 1808-09, page 192).

19. Fees of county treasurers on sale of unseated lands for taxes, are as follows: Advertising each tract, including printer's charge, 50 cents; selling each tract or part thereof, 37 cents; writing and signing every deed, $1.50; acknowledging every deed, 25 cents; writing and filing every bond to secure purchase, 25 cents.

Act March 28, 1814, section 24, (P. L., 1813-14, page 364).†

20. No fee to be charged by county treasurer for advertising any land for sale for non-payment of tax, when owners pay the same on or before March first previous to day of sale in year advertisement is made.

Act April 21, 1856, section 4, (P. L., page 477).

21. Notice of sales of unseated lands for taxes, by county treasurer, to be also given by written or printed advertisements, set-up in at least three public places, one of which to be at the court house, stating that sales for arrearages of taxes will commence on a certain day; and each treasurer to make sale, in whole or in part, of such tracts as he finds necessary to pay arrearages of tax and costs, and to execute deeds to purchasers, and acknowledge the same in open court of common pleas; and to take from purchasers bonds with warrants of attorney annexed for any surplus money that may remain after satisfying and paying taxes and costs, and to file said

*See act April 11, 1838, section 4, (P. L., 1837-38, page 325), as to sale of unseated lots in borough of Beaver, in Beaver county; acts may 4, 1864, (P. L., page 765), and April 11, 1866, (P. L., page 620), as to Berks county; act April 5, 1842, section 6, (P. L., page 242), as to Dauphin county; act April 8, 1842, section 18, (P. L., page 261), as to Lebanon county; act March 6, 1868, section 1, (P. L., page 275), as to Lycoming county; act March 2, 1867, (P. L., page 340), as to Centre county. See also section 1, act March 30, 1897, *post*, requiring six weeks notice of sales of unseated lands, to be given.

†See act April 11, 1866, (P. L., page 711), as to Luzerne and Clearfield counties; act March 18, 1868, (P. L., page 375), as to Bedford county; act February 20, 1867, (P. L., page 226), as to Northumberland county; act March 18, 1870, (P. L., page 491), as to Centre county; act April 2, 1870, (P. L., page 832), as to Clinton county; act March 16, 1871, (P. L., page 571), as to Lycoming county; act June 2, 1871, (P. L., page 134), as to Carbon county; act March 1, 1870, (P. L., page 283), as to Elk and Forest counties.

bonds in office of prothonotary, together with one attested copy of the advertisements set-up by him.

Act April 3, 1804, section 2, (P. L., 1803-04, page 519); act April 4, 1809, section 1, (P. L., 1808-09, page 192); act March 13, 1815, section 1, (P. L., 1814-15, page 177).*

22. Surplus bonds to be acknowledged by obligor before an officer authorized to take acknowledgments, and deposited with county treasurer, before deeds are lifted by purchasers; and county treasurer to have surplus bonds recorded in prothonotary's office, in surplus bond record; such bond record to be indexed in alphabetical order, and bonds to be filed in prothonotary's office after they are recorded.

Act May 8, 1895, section 1, (P. L., page 47).

23. Prothonotary to receive from purchasers or obligors a fee of fifty cents for recording and indexing surplus bonds; and to give certified copies when requested, and such certificate to be received in evidence.

Act May 8, 1895, section 2, (P. L., page 47).

24. Purchasers to pay purchase money, or sufficient portion of same to pay taxes and costs, soon as deeds are tendered them, after acknowledgment in open court, also, a fee of one dollar for use of prothonotary, for entering record of acknowledgment; and in case of failure to make payment, county treasurer to sue for and recover purchase money; and there is to be no stay of execution, nor is defendant permitted to give in evidence any irregularity in assessments or proceedings relative to sales.

Act March 13, 1815, (P. L., 1814-15, page 178).

25. In case of failure to pay purchase money and prothonotary's fee, sales may be avoided, and property re-sold; and it shall be discretionary with county commissioners what lands they will purchase for use of county.

Act March 13, 1817, (P. L., 1816-17, page 111).

26. Bonds taken for surplus moneys and filed with prothonotary, to be liens from date of deeds, on lands sold; and owners of lands at time of sale, or their legal representatives, may cause action to be entered on prothonotary's docket any time within five years from time of sale; and execution to issue for moneys mentioned in bonds, together with legal interest, if not paid within three months after entry of action, as aforesaid.

Act April 3, 1804, section 4, (P. L., 1803-04, page 521).

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*See act May 5, 1841, section 12, (P. L., page 347), as to Pike and Monroe counties.

27. Executors and administrators may collect bonds given for surplus moneys arising from sale of unseated lands of decedents, and moneys so collected to be assets in hands of executors and administrators; but courts, on application of heirs, creditors or devisees, may suspend or prevent collection of moneys, if in their opinion such collection may operate injuriously on the interests of heirs, creditors or devisees.

Act April 14, 1840, section 4, (P. L., page 351).

28. When debtors die seized of unseated lands on which their debts become liens, and said lands are sold for taxes, their executors and administrators authorized to collect bonds given for surplus moneys; and moneys collected to be paid into court of common pleas for distribution, subject to right of appeal as in cases of sheriff's sales.

Act April 14, 1840, section 5, (P. L., page 351).

29. Sales of unseated lands for taxes, made as directed by law, to rest in purchasers all the estate and interest therein that the real owners had at the time of the sale, although the same may not have been taxed or sold in the name of the real owners.

Act April 3, 1804, section 5, (P. L., 1803-04, page 522).

30. In all public sales of lands made by county commissioners and county treasurers in pursuance of law, the rule of *caveat emptor* to apply, except in cases of double assessments, or where the taxes on which sales are made have been previously paid, or where the lands do not lie within the county; and county commissioners and county treasurers shall not be required to refund the purchase money, costs or taxes paid upon tracts of land sold as aforesaid.

Act April 21, 1856, section 1, (P. L., page 477.)*

31. All sales of seated or unseated lands for arrearages of tax to be valid irrespective of the fact whether the lands were seated or unseated at the time of the assessment of the taxes; but this not to validate or authorize the sale of any land which was seated at the time of the assessment of taxes thereon, when there was sufficient personal property on the premises to pay the taxes assessed thereon, liable to seizure therefor.

Act June 3, 1885, (P. L., page 71).

32. In case a county treasurer who has sold unseated lands for taxes dies or is removed from office before deeds to purchasers are executed, his successor is to perfect title and execute such deeds,

*See act April 8, 1851, section 4, (P. L., page 356), as to Lycoming, Clinton, Sullivan and Centre counties; act April 8, 1864, (P. L., page 349), as to Columbia county; act April 10, 1867, (P. L., page 1008), as to Cambria county.

and to do all other matters and things that could or ought to have been done by the former treasurer.

Act March 13, 1815, section 2, (P. L., 1814-15, page 178).

33. When unseated lands have been advertised for sale by a county treasurer, and remain unsold at and after the expiration of the term of office of the treasurer, and said treasurer absconds, his successor in office is to advertise and sell the lands so remaining unsold, on the second Monday of June of the year intervening between the regular sales.

Act June 11, 1879, section 1, (P. L., page 151).

34. Such sales to be for the same taxes (and none other) for which the lands had been advertised to be sold at the last preceding regular sale.

Act June 11, 1879, section 2, (P. L., page 151).

35. Advertisement and sale to be made in the manner specified and subject to provisions of act of March 13, 1815, and its several supplements, but advertisement to be made in a newspaper published in the county, at least once a week for four successive weeks in the month of May; and owners to have same right of redemption as is provided in said act of March 13, 1815.

Act June 11, 1879, (P. L., page 151).*

36. Ejectments for unoccupied lands sold for taxes may be brought against and served on the persons who purchased the lands. If such persons cannot be found in the proper county, the court, after the return day of the writ, may grant rule on defendants to appear and plead; and such rule to be published for sixty successive days in a daily or weekly newspaper of the proper county. If no person appears, the court, on proof of publication in open court, to give judgment by default; but when purchasers or persons claiming under them appear, court to make them defendants, and cause to be tried on the titles of the parties as if there was an actual occupation of the land.

Act March 29, 1824, section 4, (P. L., 1823-24, page 168).

37. The right to bring action of ejectment extended to all persons having any title derived from or by virtue of a sale of unseated lands for non-payment of taxes, whether such sale be made by county commissioners or county treasurer.

Act April 14, 1851, section 16, (P. L., page 615).

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*See section 1, act March 30, 1897, *post.*, requiring six weeks' notice of intended sales of unseated lands for non-payment of taxes.

38. Owners of lands sold for taxes can redeem the same, within two years from date of sales, by paying or tendering payment to county treasurer of amount of taxes for which lands were sold and costs, and twenty-five per cent. additional; and county treasurer to receive and receipt for said moneys, and pay the same over to the purchasers, on demand. In case county treasurer refuses payment or if owners pay taxes previous to sale, then said owners can recover the lands by due course of law. Former act requiring notice to be given in newspapers of taxes being due and sale thereon, repealed; and no alleged irregularity in assessment, or in process or otherwise, to affect title of purchaser. In cases where owners of lands sold for taxes are orphans or insane, and residing within the United States, two years after such disability is removed, is allowed them or their legal representatives to bring suit for recovery of lands sold for non-payment of taxes; but where recovery is effected in such cases, the value of the improvements made on the lands, after the sale of the same, is to be ascertained by the jury trying the action for recovery and to be paid by the persons recovering the same, before they obtain possession of the lands so recovered.

Act March 13, 1815, section 4, (P. L., 1814-15, page 178).

39. Word "orphan" or "orphans" to be taken and construed to mean minor or minors.

Act April 25, 1850, section 30, (P. L., page 574).

40. No action for recovery of lands to lie, unless brought within five years after the sale of the same for taxes.

Act April 3, 1804, section 3, (P. L., 1803-04, page 521).

41. Persons having liens or equitable interests in lands sold for taxes, and their legal representatives, may redeem the same from the effects of sale, as fully as the owner of the lands at the time of the sale can do; and when time of redemption has expired such persons or their legal representatives authorized to collect surplus as fully as owners at time of sale can do, but moneys, when collected, to be paid into and distributed by order of court, subject to right of appeal, as decrees for distribution of moneys arising from sheriffs' sales are by law subject.

Act April 14, 1840, section 6, (P. L., page 352).

42. Joint owners of unseated lands sold for non-payment of taxes, may, within two years from date of sale, redeem their proportionate share of said lands, by tender of their proportionate amount of tax, costs and twenty-five per cent. additional sum; and county treasurer to receive and receipt for the same, and pay the same over to the purchasers, on demand made. In such cases, joint tenants entitled to

recover their share and interest in said lands, and to hold the same, with the purchasers, as tenants in common.

Act March 9, 1847, section 3, (P. L., page 279).

43. In cases of sales of tracts of unseated lands for taxes, which may be interfered with by surveys or titles of other claimants, such claimants are authorized, within two years from date of sales, to tender amount of taxes upon so much of said tracts as are included within the lines under which claimants hold title, and costs, and their proportionate amount of the additional twenty-five per cent., and county treasurer is required to receive and receipt for the same, and pay it over to the purchasers, on demand; and said redemption to be as effectual for protection of claimants' title within the lines of their surveys or claims as if the redemption had been made for and included all the land within the lines of said interferences.

Act April 3, 1862, (P. L., page 228).

44. Redemption moneys paid by lien creditors to be liens upon such title of debtors as would have passed to purchasers under the sale, if no redemption had been made, and to have priority over other liens against the same title. Lien creditors or their legal representatives thus redeeming lands, to have claims or receipts for redemption money entered as costs on the record where the lien is entered or recorded; and said claim to be treated as docket costs in the proper judgment or mortgage lien, and to be preferred in the distribution of the proceeds of any subsequent sale of said property.

Act May 15, 1874, (P. L., page 192).

45. Value of improvements to be recovered in all cases where a recovery is effected against a purchaser at a sale for taxes, or other person claiming under him; such recovery to be an incident in all cases where there is a recovery against the tax title, without regard to the nature of the defects of said title; and whenever any person claiming under such tax title may be out of possession, and on account of defects in the title fail to recover the land, the jury, under the direction of the court, to assess the value of the improvements, and fix the time within which the assessment shall be paid by the defendant. If the assessment is not paid within the time specified by the jury, the title of the plaintiff to land in dispute to be confirmed as against defendant and all claiming under him. On failure to pay such assessment, a writ of *habere facias possessionem* may issue forthwith, without any other proceeding; and in all cases where a recovery is had against a defendant claiming under a tax title, the jury assessing the value of the improvements to find the time, under the direction of the court, within which the assessment

is to be paid by the plaintiff, and on failure to pay the same within said time the title of the defendant to be good and valid against plaintiff and all claiming title under him. No improvements made within two years after sale of lands for taxes, to be paid for by party recovering or purchasing the same. If defects in tax title are known to purchaser at time of sale, or if tender of redemption money is made within two years of sale, he is not to be allowed for his improvement. This not to affect the interests of minors who claim the lands within two years after they arrive at age.

Act April 12, 1842, section 20, (P. L., page 265).*

46. Redeeming owners of unseated lands sold for non-payment of taxes, to repay taxes paid by purchasers that accrued between time of sale and period fixed for redemption.

Act May 8, 1855, (P. L., page 519).

47. Receipts for redemption money to be recorded by prothonotary, who shall mark the word "redeemed" on margin of entry of the deed of the tract of land redeemed, and note the page of the book where such receipt is entered; and to receive a fee of twenty-five cents for each tract for which receipt is recorded. Receipt to be returned to owner on completion of entry. When handwriting of county treasurer is not known to prothonotary, he is not to enter receipt until the same is probated, and such probate is to be recorded with the receipt; and the recording of any receipt to be as good evidence in any court as the original receipt would be. This not to affect the rights of persons acquired under existing laws.

Act April 14, 1840, section 7, (P. L., page 352).

48. All receipts of county officers for redemption of moneys of unseated lands sold for non-payment of taxes, to be recorded.

Act April 25, 1850, section 33, (P. L., page 575).

49. Unseated lands offered for sale, not bringing taxes and costs, to be purchased by county commissioners, and deed to be made to county commissioners for use of county. County commissioners to provide book, in which shall be entered name of person whose lands are sold, quantity of land and amount of taxes lands were sold for; and such lands not to be charged in collector's duplicate so long as they remain the property of the county. County commissioners to charge said lands with reasonable county and road tax for five years following date of sale, if they remain unredeemed that long.

Act March 13, 1815, section 5, (P. L., 1814-15, page 179).

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*See act March 11, 1843, section 2, (P. L., page 79), as to lands belonging or supposed to belong to estate of John Nicholson, deceased.

50. Right of redemption to remain in owners of lands for five years after sale; and on payment to county treasurer of taxes, costs and interest thereon, and also taxes assessed on lands from year to year after sale, and interest thereon, county commissioners to convey county's title to lands to owners, by endorsement on back of county treasurer's deed. Moneys received for road taxes to be paid to supervisors of townships where lands lie, on orders of county commissioners, to be used in making and repairing the public roads.

Act March 13, 1815, section 6, (P. L., 1814-15, page 179).*

51. Joint owners can redeem their proportionate part of lands purchased by county commissioners for non-payment of taxes, within the same time and in the same manner provided for redemption where one party is owner of the land, and county commissioners may sell residue of interests in lands not redeemed within five years, at public sale, and make deed to purchaser, who shall enjoy the same as tenant in common with the person who has redeemed his interest therein.

Act April 25, 1850, section 32, (P. L., page 574).

52. Lands not redeemed within five years may be sold by county commissioners; and thereafter such lands to be assessed against last purchaser or redeemer, and to be again liable to be sold for taxes.

Act March 13, 1815, section 7, (P. L., 1814-15, page 180; act March 29, 1824, section 1, (P. L., 1823-24, page 167).

53. County commissioners may advertise notice of intended sales of seated or unseated lands for non-payment of taxes in such number of newspapers as in their judgment seems necessary; but the maximum number not to exceed five nor the minimum number to fall below two, if so many are published in the proper county.

Act July 2, 1895; (P. L., page 421).†

54. Thirty days notice, by advertisement in newspapers, and six written or printed advertisements, of intended sales by county commissioners, to be given.

Act March 29, 1824, section 1, (P. L., 1823-24, page 167).*

55. Deed to be given in form prescribed by law, and sales to be entered in minute book of county commissioners, also, redemptions.

Act March 13, 1815, section 9, (P. L., 1814-15, page 180).

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*See act April 8, 1862, (P. L., page 317), as to Jefferson and Potter counties.

†See section 1, act March 30, 1897, *post.*, requiring six weeks' notice of intended sales of unseated lands for non-payment of taxes.

*See section 1, act March 30, 1897, *post.*, requiring six weeks' notice of intended sales of unseated lands for non-payment of taxes.

56. County commissioners, empowerd to execute deeds in fee simple, to purchasers; and such deeds, after being acknowledged, to be good and valid for such title as county commissioners had a right to convey.

Act March 29, 1824, section 2, (P. L., 1823-24, page 167.)†

57. County commissioners' deeds not acknowledged before a justice of the peace, before delivery, to be valid, upon proof of execution by subscribing witnesses.

Act April 9, 1872, (P. L., page 45).

58. Notice of intended sales of unseated lands for non-payment of taxes to be given once a week for six successive weeks, in at least two newspapers of general circulation, or if two newspapers be not published in a county, then in one newspaper nearest the same. Notice to contain names of owners of lands, if known, warrant numbers of tracts, names of warrantees, when known, number of acres contained in each tract, township in which located, and taxes due on each tract; and ten copies of advertisement to be mailed by county treasurer or county commissioners to Secretary of Agriculture, and ten copies to Commissioner of Forestry.

Act March 30, 1897, section 1, (P. L., page 11).‡

59. Commissioner of Forestry to examine location and character of lands, and if desirable for forestry reservation he may purchase same, on behalf of Commonwealth, subject to right of redemption under existing laws. Price paid for lands not to exceed amount of taxes for non-payment of which lands are sold, and costs. Auditor General to draw warrant on State Treasurer, payable to order of county treasurer, for amount of purchase money, upon certificate of Commissioner of Forestry.

Act March 30, 1897, section 2, (P. L., page 11).

60. In case of redemption of lands, redemption money to be remitted to State Treasurer by county treasurer, with description of tract redeemed.

Act March 30, 1897, section 3, (P. L., page 12).

61. Title to lands purchased to be vested in Commonwealth, if not redeemed within the time limited by law. County treasurer to certify to Secretary of Agriculture lists of unredeemed lands purchased by Commonwealth, together with description of the same;

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†See section 10, act May 3, 1852, (P. L., page 522), as to effect of county commissioners' deeds in Centre county.

‡See section 1, act March 13, 1815, sections 1 and 5; act March 29, 1824, sections 1 and 2; act March 9, 1847, section 2; act June 11, 1879, and act July 21, 1895, *ante.*, as to advertisement of notice of intended sales of unseated lands for non-payment of taxes.

and such lands not to be subject to further taxation whilst owned by Commonwealth. Secretary of Agriculture to keep record of all lands acquired by Commonwealth.

Act March 30, 1897, section 4, (P. L., page 12).

62. Lands acquired by Commonwealth to be under control of Department of Agriculture, in care of Division of Forestry; and to be part of forestry reservation system for preservation of water supply and protection from floods.

Act March 30, 1897, section 5, (P. L., page 12).

EXEMPTION FROM TAXATION.

1. All churches, meeting houses, or other regular places of stated worship, with the grounds thereto annexed necessary for the occupancy and enjoyment of the same; all burial grounds not used or held for private or corporate profit; all hospitals, universities, colleges, seminaries, academies, associations and institutions of learning, benevolence or charity, with the grounds thereto annexed necessary for the occupancy and enjoyment of the same, found, endowed and maintained by public or private charity; and all school houses belonging to any county, borough or school district, with the grounds thereto annexed and necessary for the occupancy and enjoyment of the same; and all court houses and jails, with the grounds thereunto annexed, are exempt from all and every county, city, borough, bounty, road, school and poor tax; but all property, real or personal, other than that which is in actual use and occupation for aforesaid purposes, and from which any income or revenue is derived, is to be subject to taxation, save where exempted by law for State purposes.

Act May 14, 1874, (P. L., page 158).*

*Prior to this act nothing was taxable except that which was expressly taxed by statute, and so far as the latter portion of this act seeks to impose a tax upon new subjects of taxation, it discloses a purpose not mentioned in the title of the act, and is unconstitutional and void, under article III, section 3, of the State Constitution. Sewickley Borough vs. Sholes, 118 P. S. R., page 165. See act April 21, 1841, section 9, (P. L., page 253), as to exemption of public property in Pittsburg, and act April 10, 1873, (P. L., page 597), as to machinery in Montgomery county. Funds held in trust for charitable and religious objects are exempt from taxation, General Assembly vs. Gratz, 139 P. S. R., page 497. See act April 8, 1873, (P. L., page 64), which this act supplies, also act May 12, 1871, (P. L., page 771), as to exemption of burial grounds from taxation in Philadelphia. Said act of April 8, 1873, exempts from taxation burial lots, lunatic asylums, almshouses, poorhouses, houses of refuge, penitentiaries and asylums, schools and hospitals supported by annual appropriations from the Commonwealth. Act of April 9, 1873, (P. L., page 68), repealed all laws theretofore passed, that exempted the indebtedness of counties, cities and boroughs from taxation for State purposes.

2. Buildings in course of erection to be exempt from taxation, if exempt when completed.

Act June 4, 1879, (P. L., page 90).

3. County bonds, owned by a public corporation within the county issuing the bonds, the income from which is by law appropriated exclusively to the support of the poor and the maintenance of the public roads of the county, are exempt from taxation for State purposes.

Act March 24, 1877, (P. L., page 44).

4. So much of the capital stock and shares of corporations, limited partnerships or joint stock associations organized for manufacturing purposes, as is invested in and actually and exclusively employed in carrying on manufacturing within the Commonwealth, except companies engaged in the manufacture of spirituous and malt liquors and such as enjoy and exercise the right of eminent domain, are exempt from taxation.

Act June 8, 1893, (P. L., page 355); act June 8, 1891, section 5, (P. L., page 238); act June 1, 1889, section 21, (P. L., page 431); act June 30, 1885, section 20, (P. L., page 199).

5. The capital stock and shares of stock of building and loan associations, except prepaid and matured stock, are exempt from taxation.

Act June 8, 1891, section 1, (P. L., page 421); act May 22, 1883, (P. L., page 38); act July 15, 1897, section 2, (P. L., page 294).

6. Assessors to make return to county commissioners of all property exempt from taxation, in a separate list, for which service they receive the same compensation as is allowed for like services in other cases.

Act April 5, 1849, section 5, (P. L., page 962).

SPECIAL PROVISIONS AS TO CITIES OF THE THIRD CLASS.

1. Cities of third class empowered to enact ordinances for levy and collection of taxes for general revenue purposes, not to exceed ten mills on the dollar in any one year, on all persons, and on real, personal and mixed property within the limits of the cities taxable for county purposes.

Act May 23, 1889, article V, section 3, clause 1, (P. L., page 286).

2. Also empowered to provide for assessment and collection of an additional tax, not exceeding one per centum on the dollar upon the assessed valuation in any one year on all persons, property and other matters and things in said cities taxable for county purposes, for the payment of interest on bonded indebtedness, and for the payment of loans to support the government and to make the necessary improvements in said cities.

Act May 23, 1889, article V, section 3, clause 2, (P. L., page 286).

3. Further empowered to place a poll tax for general revenue purposes, not exceeding one dollar annually, on all male inhabitants above the age of twenty-one years.

Act May 23, 1889, article V, section 3, clause 3, (P. L., page 287).

4. Such cities can, by ordinance, levy and collect for general revenue purposes, an annual license tax not exceeding $100 on all auctioneers, contractors, druggists, hawkers, peddlers, produce or merchandise vendors, bankers, brokers, pawnbrokers, merchants of all kinds, persons selling or leasing goods upon instalments, grocers, confectioners, butchers, restaurants, bowling alleys, billiard tables and other gaming tables, drays, hacks, carriages, omnibuses, carts, wagons, street railway cars and other vehicles used in the cities for hire or pay, lumber dealers, including commission men and all persons who make a business of buying lumber for sale at wholesale or retail, furniture dealers, saddle or harness dealers, stationers, jewelers, livery or boarding stable keepers, real estate agents, agents of fire, life or other insurance companies, market house companies, express companies or agencies, telegraph, telephone, steam heating, gas, natural gas, water, electric light or power companies or agencies, or individuals furnishing communication, light, heat or power by any of the means enumerated, and to regulate the collection of the same.

Act May 23, 1889, article V, section 3, clause 4, (P. L., page 287).

5. Said cities empowered, by ordinance, to levy and collect taxes on all taxable property in the cities, in addition to all other taxes, for the purpose of paying the bonded indebtedness of the cities, subject to the limitations and requirements of this act and the constitution and laws of the Commonwealth.

Act May 23, 1889, article V, section 3, clause 7, (P. L., page 288).

6. May by ordinance license and collect license from skating rinks, operas, theatres, concerts, shows, circuses, menageries and all kinds of public exhibitions for pay, except those for local, religious, educational or charitable purposes.

Act May 23, 1889, article V, section 3, clause 25, (P. L., page 291).

7. And levy and collect license from persons authorized to occupy any portion of the streets or sidewalks for temporary public market purposes.

Act May 23, 1889, article V, section 3, clause 3, (P. L., page 292).

8. And regulate and provide for taxing the owners and harborers of dogs.

Act May 23, 1889, article V, section 3, clause 30, (P. L., page 292).*

9. Cities of third class having previously incurred a debt for the purpose of improving or maintaining public parks, empowered to levy a tax to provide for the payment of such indebtedness as it matures; and may classify real estate with reference to its benefits from said parks, in the proportion each property shall appear to be benefited, and to levy tax accordingly. City assessors to make classification, and same to remain subject to changes rendered necessary by changes of city property lines.

Act March 25, 1878, section 1, (P. L., page 8).

10. Councils to fix time for assessors to hear appeals on matter of classification, and direct notice to be given; after hearing appeals and making changes, classification to be final and conclusive.

Act March 25, 1878, section 2, (P. L., page 8).

11. Former tax validated.

Act March 25, 1878, section 3, (P. L., page 8).

12. Act not to go into effect until accepted by councils.

Act March 25, 1878, section 4, (P. L., page 9).

13. Each city of the third class to elect three persons, residents of the city for at least five years prior to their election and owners of real estate therein, to serve as a board of assessors for three years from first Monday of April succeeding their election. No two of the said board to be residents of the same ward.

Act May 23, 1889, article XV, section 1, (P. L., page 317).

14. To be sworn and file oath with city clerk; vacancies may be filled by councils. During first year of their term of service, and every third year thereafter, may appoint assistant assessors not exceeding in number the number of wards of the city, to serve not exceeding sixty days, and to be removable at the pleasure of the board. Compensation of board and assistants to be fixed by councils.

Act May 23, 1889, article XV, section 2, (P. L., page 317).

15. Board to make assessment of property subject to taxation for city purposes in year of triennial assessment for county purposes,

*See also act June 10, 1881, (P. L., page 112); act May 25, 1893, (P. L., page 136).

and a list of property exempt from taxation, with a valuation of the same; to return dimensions of lots or pieces of ground, with number and kind of improvements thereon; and a similar assessment to be made every three years. To value property at such sum it would bring at a fair public sale. To make assessment as directed by precept of board of revision and appeal, in years succeeding triennial assessment. To complete annual assessment on or before January first.

Act May 23, 1895, section 1, (P. L., page 119).

16. Board to give taxables at least five days notice of their ratings, and of any changes in assessments in intervening years, together with time and place of hearing appeals by board of revision. Persons aggrieved by the action of the board of assessors may appeal to board of revision.

Act May 23, 1895, section 2, (P. L., page 120).

17. Councils, in joint convention, on or before first Monday of May, every third year, to elect five resident citizens as a board of revision and appeals, to serve for three years, and to be sworn. Vacancies to be filled by councils for unexpired term. No member of councils to vote for more than three members of board, and the five persons receiving the highest number of votes to be declared elected. Board may issue their precept to city assessors, on or before the first day of September, requiring new assessment, in whole or in part, in years other than triennial year; to receive assessments returned by board of assessors, and to have the power to revise, equalize or alter assessments, and to add to assessments and tax duplicates any subject of taxation omitted therefrom. Property ceasing to be exempt from taxation, for purposes that entitled it to exemption, to become taxable for proportionate part of year it was not entitled to exemption. Board to rectify all errors, and may require attendance of board of assessors and assistant assessors, or other citizens, for examination on oath; to hear and determine all appeals by taxpayers from assessments made by city assessors, at such time and place as they may prescribe, of which five days' notice to be given; to give five days' notice to taxable inhabitants of any increase or addition to the valuation assessed against them by the board of city assessors, together with time and place of appeal. Board empowered to administer oaths on all matters before them, and false statements under oath to be deemed perjury and be punishable as such. Members of board to receive compensation fixed by councils, not exceeding four dollars per day for each day discharged in the performance of duty. City clerk to act as clerk of board, and to receive for his services such compensatioon as councils shall fix.

Board to have custody of books relating to assessment of city tax, and to keep them arranged according to wards and dates; to furnish books to city assessors for taking assessments, and such books to be returned to board on completion of assessments. Board to complete their labors and the hearing and determination of appeals on or before March first, after which the assessment is to be copied by wards into duplicates, and to remain as the lawful assessment for city tax, until altered as provided in this act. Decision of board to be subject to appeal to court of common pleas, whose decision shall be final, and appellant to pay costs if appeal is declared groundless.

Act May 23, 1895, section 3, (P. L., page 120).

18. Duplicates, when completed, to be placed in possession of city treasurer, on or before the first day of June, who is to receive and collect the taxes. Three per centum to be added to taxes remaining unpaid on the first day of September, and on the first day of each month thereafter one per centum to be added to all outstanding taxes until the same are fully paid.

Act May 23, 1889, article XV, section 7, (P. L., page 319).

19. On first day of November, city treasurer to place duplicates of unpaid taxes in hands of collectors by him appointed, with his warrant for their collection, and such collectors to receive for their services the compensation councils authorize. Collectors to give bond in a sum equal to the amount of taxes in their duplicates, with two sureties to be approved by councils; and to have and exercise the powers vested by law in collectors of State and county taxes, and may, after five days' notice, seize any property on the premises assessed, whether belonging to tenants or others, without regard to date of assessment of tax, and may levy upon any personal property of delinquents found within the county, for collection of the tax.

Act May 23, 1889, article XV, section 8, (P. L., page 319).

20. Collectors to collect tax and make monthly returns and payments to city treasurer, and real estate tax thus paid to be satisfied upon duplicates remaining in city treasurer's office; and such collectors to settle their duplicates within five months from the time they came to their hands, and pay over amounts charged against them, exclusive of exonerations.

Act May 23, 1889, article XV, section 9, (P. L., page 319).

21. Schedule of unpaid city taxes, together with descriptions of properties against which assessed, and affidavits of collectors that sufficient personal property out of which taxes can be made, in whole or in part, cannot be found, to be furnished city treasurer by collectors within five months after duplicates are placed in their hands.

Failure of collectors to collect tax from personal property, not to impair lien of tax or affect validity of sale made in collection of tax. Collectors making wilfully false returns, to be liable for persons injured thereby.

Act May 23, 1889, article XV, section 10, (P. L., page 319).

22. Upon return of schedules of unpaid city taxes, city treasurer to certify the same, or a copy thereof, to the city solicitor, who shall cause the taxes, with the penalties on the same, to be registered in the prothonotary's office. Prothonotary to be allowed a fee of twenty-five cents for each tax registered, to form part of costs, and be paid by person from whom tax is due. Prothonotary to also make searches and furnish transcripts or extracts from register of taxes, on payment of his fee therefor.

Act May 23, 1895, section 4, (P. L., page 122).

23. Taxes assessed upon real estate to be liens thereon from date of assessment and levy thereof until paid. Lien to have priority to and be fully paid before any recognizance, mortgage, judgment, obligation, lien or responsibility, which the said real estate may become charged with or liable to; not to be divested by any judicial sale, except for so much of the proceeds of such sale as shall be actually applied thereto; and defendants or others in writs of *fieri facias*, *venditioni exponas or levari facias*, not to claim any exemption under levy and sale of any real estate charged with tax, against the allowance or payment of the same.

Act May 23, 1895, section 5, (P. L., page 123).

24. City treasurer, if councils direct, to advertise lands returned to him for non-payment of tax, and to sell same on first Monday of June or such subsequent day as sale may be adjourned to; if there is not sufficient time to advertise before first Monday of June, sale to be on first Monday of June of the next year. Lands to be advertised once a week for three successive weeks before day of sale in two newspapers, if so many are published in the city. No sale to be valid if taxes are paid before return, or taxes and costs after return and before sale. Lands may be redeemed by owner or any one interested within two years after sale, by payment to city treasurer of amount of taxes paid at sale and five per centum penalty thereon, also all taxes on the lands paid by the purchaser and a further penalty of one per centum per month on the amount of taxes paid at such sale or any time subsequent thereto. If bid is less than the taxes and costs charged on the lands, the persons redeeming required to pay full amount of taxes, costs and penalty. City may bid amount of taxes and costs, and purchase lands if necessary.

Act May 23, 1889, article XV, section 13, (P. L., page 320).

25. Purchasers of lands sold at city treasurer's sale, to pay purchase money or such part thereof as is necessary to pay all taxes and costs, and $1.50 for prothonotary for entering report of treasurer and acknowledgment of deed, as soon as property is struck down, or in default thereof, the sale may be avoided and the property be immediately put up again by the treasurer. This section not to apply when lands are purchased by city treasurer.

Act May 23, 1889, article XV, section 14, (P. L., page 321).

26. City treasurer to make report and return to first term of court of common pleas, giving description of lands sold, names of persons (where known) in which the property is assessed, amount of tax and year for which assessed, the time and newspapers in which advertisements for sale were made, with copy of advertisement, time of sale, names of purchasers, and price for which sold; and report of return and sales to be confirmed *nisi*, if it appears to court, on presentation of report, that sales have been regularly conducted; if no objections or exceptions are filed to said sales within ten days, a decree of absolute confirmation may be entered by prothonotary. In case objections or exceptions are filed, they are to be disposed of according to the practice of the court, and when they are overruled or set aside a decree of absolute confirmation is to be entered; but objections and exceptions are to be confined to the regularity of the proceedings of the treasurer.

Act May 23, 1889, article XV, section 15, (P. L., page 321).

27. After sales have been confirmed, purchasers to give bond, with warrant of attorney to confess judgment, annexed thereto, in all cases where bid exceeds taxes and costs; and city treasurer to file bond in prothonotary's office, and the same to become a lien on the lands sold, and owners of lands at time of sale, or their legal representatives, may at any time within five years thereafter cause judgment to be entered on said bond, and if moneys due thereon are not paid within three months execution may be issued for the recovery of the same.

Act May 23, 1889, article XV, section 16, (P. L., page 322).

28. When purchaser has paid such portion of his bid as he is required to pay and given surplus bond, city treasurer to make him deed for lands sold; and such deed to be acknowledged in court of common pleas, and acknowledgment to be entered by prothonotary in treasurer's deed book, and prothonotary to receive a fee of $1.50 for such service.

Act May 23, 1889, article XV, section 17, (P. L., page 322).

29. In cases of redemption of lands sold for non-payment of city tax, city treasurer to acknowledge receipt of redemption moneys

on margin of deed, and deed to be void thereafter; and owners, or other persons interested in lands, to have treasurer's deed delivered up to them for cancellation.

Act May 23, 1889, article XV, section 18, (P. L., page 322).

30. City treasurer to expose to public sale on succeeding first Monday of June, or any day to which sale is adjourned, lands remaining unsold and lands where purchasers do not comply with the terms of the sale.

Act May 23, 1889, article XV, section 19, (P. L., page 323).

31. Special taxes and assessments made for water-frontage tax, sewerage tax, piping, paving, re-paving, curbing or re-curbing sidewalks, grading, macadamizing or paving public streets, lanes and alleys, or parts thereof, and for assessments of damages or benefits, and contributions for opening, widening or vacation thereof, or the changing of water courses, and for all other purposes except general taxes, to be paid within the time provided by ordinances of councils, and if not so paid, five per centum to be added thereto, and claim also to bear interest at rate of six per centum per annum.

Act May 23, 1889, article XV, section 20, (P. L., page 323).

32. Special taxes and assessments to be first liens on lands fronting on streets in which improvements are made, or on the lands assessed for improvements and benefits, from the commencement of improvements for which assessments were made until six months after completion of work, and no longer, unless lien is filed within said period, in prothonotary's office, in city lien docket. Prothonotary entitled to a fee of twenty-five cents for filing and entering lien, to be taxed as part of the costs. Specification of lien to be sufficient if it designates date and amount of assessment, land assessed, and name of owner or reputed owner, and to have effect of extending lien for ten years from date of entry, and to be amendable at and before trial in such manner as will meet the facts and merits of the case; to have priority and be fully paid before any other lien or incumbrance with which the land assessed may become charged, and not to be divested by judicial sale except as to such portion of the proceeds of the sale as is actually applied to the payment of the lien.

Act May 23, 1889, article XV, section 21, (P. L., page 323).*

33. Recovery may be had on claims for city taxes, water frontage tax, lighting frontage tax, water rates, lighting rates, sewerage tax,

*Altered as to taxes assessed on real estate, by section 12, act May 23, 1895, (P. L., page 123). See also other provisions of act of May 23, 1889, article XIII-XVII, (P. L., page 312-330), as to municipal claims and assessments not herein specifically stated.

piping, paving, re-paving, curbing or re-curbing sidewalks, grading, macadamizing or paving any public street, lane, alley or part thereof, or for assessments for damages or benefits and contributions imposed for the opening or vacation thereof, or changing of water courses, and all other matters that may be the subject of claim registered in pursuance of this act, and the laws and ordinances of any city of the third class, in the court of common pleas of the proper county, or before any magistrate having jurisdiction, of the amount, by action at law to recover a general judgment against the owners of property on which assessments were made, or proceedings may be had by *scire facias* similar to proceedings in the case of mechanics' claims; and claims so registered to be *prima facie* evidence of the amount thereof, and of the same being due and owing, and of all matters therein set forth; and judgment to be entered by default thereon, unless defendants file affidavits of defence where plaintiff has filed a copy of his cause of action, and judgment and process thereon to be with like effect as in other cases. Copy of claim need not be filed when reference is made to number and term and page on which claims are registered in the praecipe instituting the suit. Where real estate subject to lien has been conveyed and deed recorded after registry of tax, the then owner to be included in the process, and if any owner is omitted he may be brought in by rule of court, or *alias scire facias* to show cause why he should not be made a party to the suit; and on proof of service thereof, judgment may be entered for default of appearance or affidavit of defence.

Act May 23, 1889, article XV, section 22, (P. L., page 323).

34. A sale of property on a writ of *levari facias* issued on judgment obtained on lien, to be deemed a proceeding *in rem*, and to vest a good title in purchaser, whether real owner be named or not. Owners of property sold, not personally served with *scire facias*, may redeem same within one year from date of sale, by payment of purchase money, taxes and moneys expended on improvements of property, and ten per cent. added thereto; and persons entitled to redeem may petition court from which process issued, setting forth facts and readiness to pay redemption money, and court to grant rule to show cause why property shall not be re-conveyed to petitioner, to be served as directed by court; and if petitioner prove facts necessary to entitle him to redeem, court to make rule absolute and enforce it by attachment.

Act May 23, 1889, article XV, section 23, (P. L., page 324).

35. When owner of a lot is unknown, claim to be filed against land assessed and "unknown owner," and indexed accordingly. *Scire facias* may issue thereon, and to be published by sheriff once a week

for three successive weeks before return day in at least one newspaper published in the city, with description of lot, amount assessed thereon, and for what purpose. Owner may defend, if he appears, but if there is no appearance, judgment may be entered and land sold, with like effect as if real owner had been named as defendant and personally served with writ.

Act May 23, 1889, article XV, section 24, (P. L., page 325).

36. City can purchase lands offered for sale for non-payment of tax or claim. Amount bid not to exceed amount necessary to secure claims, or amounts due city, together with costs of sale.

Act May 23, 1889, article XV, section 25, (P. L., page 325).

37. In cities of third class where school district comprises the same territory as the city, school and school building tax to be levied on assessment made for city purposes.

Act May 25, 1897, section 1, (P. L., page 85).

38. City clerk, or person authorized by council, to make for use of school board, a copy of completed assessment, and certify the same to the board.

Act May 25, 1897, section 2, (P. L., page 85).

39. Councils in cities of third class to levy, in addition to other taxes, a sinking fund tax of not less than one-fourth of a mill or greater than three mills upon the assessed value of taxable property in the city, to pay interest and redeem principal of funded debt. Bonds purchased to be stamped, to show that they were purchased for sinking fund, and interest on bonds to be collected, and used like other taxes collected for sinking fund.

Act May 23, 1889, article XVIII, section 2, (P. L., page 331).*

40. At or before the time of issuing a loan authorized to be issued, cities of third class to provide for collection of an annual tax sufficient to pay interest and redeem loan within thirty years.

Act May 23, 1889, article XVIII, section 2, (P. L., page 331).

41. Any municipality increasing its indebtedness, shall, before issuing any obligations therefor, assess and levy an annual tax, to commence the first year after such increase, to be equal to, and sufficient for and applied exclusively to the payment of the interest and the principal of the debt within a period not exceeding thirty

*Altered by acts April 18, 1895, (P. L., page 37), and May 11, 1897, *post*. See also provisions of act May 23, 1889, article XIII-XVII, (P. L., pages 312-330), as to municipal assessments, not herein specifically stated.

years from the date of increase. Money arising from tax to be applied to redemption of outstanding obligations.

Act May 11, 1897, (P. L., page 54). See also act May 18, 1895, (P. L., page 37); act May 11, 1893, (P. L., page 44); act May 23, 1889, article XVIII, section 1 and 2, (P. L., page 331); act May 23, 1874, section 11, (P. L., page 234); act April 20, 1874, section 4, (P. L., page 67).

SPECIAL PROVISIONS AS TO CITIES OF THE SECOND CLASS, AND PITTSBURG AND ALLEGHENY.

See act March 22, 1877, sections 1, 2 and 4, (P. L., page 16); act March 15, 1878, section 1, (P. L., page 7); act May 22, 1878, (P. L., page 87); act June 7, 1895, (P. L., page 184); act May 5, 1876, section 5, (P. L., page 125); act June 19, 1893, section 1, (P. L., page 468); act May 5, 1876, section 2, (P. L., page 124); act June 19, 1893, section 2, (P. L., page 469); act June 14, 1887, section 23, (P. L., page 398); act May 5, 1876, section 4, (P. L., page 125); act May 8, 1895, (P. L., page 52); act July 3, 1895, sections 11 and 12, (P. L., page 593); act February 12, 1869, sections 17-21, (P. L., page 153); act January 4, 1859, sections 3, 4 and 5, (P. L., 1858, page 828); and act April 15, 1867, section 2, (P. L., page 1258); act March 22, 1877, section 5, (P. L., page 16); act April 15, 1867, section 3, (P. L., page 1258); act May 5, 1841, section 16, (P. L., page 348); act March 7, 1846, section 2, (P. L. page 78); and act March 13, 1858, (P. L., page 103); act March 18, 1875, section 7, (P. L., page 11); act March 22, 1877, section 6, (P. L., page 17); act March 15, 1878, section 2, (P. L., page 7); act March 15, 1878, section 5, (P. L., page 7); act March 22, 1877, sections 7-11, (P. L., page 17); act May 12, 1897, (P. L., page 55); act March 15, 1878, section 3, (P. L., page 7); act May 6, 1850, section 22, (P. L., page 697); act March 22, 1877, sections 13-15, (P. L., page 18); act April 11, 1862, section 4, (P. L., page 501); act April 15, 1867, (P. L., page 1258); act April 21, 1841, section 9, (P. L., page 253); act March 13, 1847, sections 3 and 4, (P. L., page 341); act March 28, 1872, sections 1-3, (P. L., page 606); act April 18, 1873, section 4, (P. L., page 811); act April 16, 1827, section 1, (P. L., 1826-27, page 437); act April 5, 1862, sections 1-7, (P. L., page 246); act April 5, 1849, section 6, (P. L., page 390); act May 16, 1857, section 4, (P. L., page 542); act April 13, 1859, section 3, (P. L., page 599); act April 18, 1873, sections 1-3, (P. L., page 810); act April 12, 1851, sections 4-8, (P. L., page 421); act May 8, 1850, sections 1 and 2, (P. L., page 707); act April 15, 1857, (P. L., page 204); act April 21, 1858, (P. L., page 388); act February 27, 1860, (P. L., page 85); act March 30, 1860, (P. L., page 363); act May 1, 1861, (P. L., page 667); act April 10, 1862, (P. L., page 399); act April 14, 1863, (P. L., page 434); act April 3, 1868, (P. L., page

632); act April 1, 1868, (P. L., page 549); act March 24, 1869, (P. L., page 498); act April 15, 1869, (P. L., page 979); act March 31, 1870, (P. L., page 717); act March 29, 1872, (P. L., page 642).

SPECIAL PROVISIONS AS TO CITIES OF FIRST CLASS AND PHILADELPHIA.

See act August 25, 1864, (P. L., page 1030); act April 21, 1858, section 1, (P. L., page 385); act May 11, 1893, (P. L., page 42); act April 26, 1893, (P. L., page 25); act June 7, 1895, sections 1 and 2, (P. L., page 170); act February 2, 1854, section 39, (P. L., page 42); act June 11, 1879, section 1, (P. L., page 130); act March 4, 1862, (P. L., page 90); act February 2, 1854, section 17, (P. L., page 32); act March 13, 1862, (P. L., page 113); act April 11, 1862, (P. L., page 495; act April 10, 1867, (P. L., page 1052); act April 11, 1859, (P. L., page 503); act April 17, 1866, (P. L., page 964); act April 22, 1863, (P. L., page 552); act April 6, 1870, (P. L., page 946); act April 18, 1857, (P. L., page 239); act March 16, 1861, (P. L., page 147); act March 28, 1867, (P. L., page 592); act March 26, 1859, sections 1 and 2, (P. L., page 262); act April 12, 1873, section 2, (P. L., page 715); act May 13, 1856, section 6, (P. L., page 568); act April 13, 1859, section 1, (P. L., page 595); act April 12, section 1, (P. L., page 715); act February 2, 1867, section 3, (P. L., page 138); act April 12, 1873, section 3, (P. L., page 715); act February 2, 1867, section 4, (P. L., page 138); act March 14, 1865, section 1, (P. L., page 320); act March 27, 1865, (P. L., page 786; act February 2, 1867, sections 1 and 2, (P. L., page 137); act March 24, 1868, section 1, (P. L., page 444); act May 13, 1856, section 7, (P. L., page 569); act April 12, 1867, sections 2 and 4, (P. L., page 715); act April 1, 1836, section 52 (P. L., page 445); act March 13, 1865, sections 2-9, (P. L., page 321); act June 1, 1885, article V, section 1, (P. L., page 43); act February 2, 1854, section 11, (P. L., page 29); act June 5, 1883, (P. L., page 79); act April 21, 1858, section 2, (P. L., page 385); act May 13, 1856, section 9, (P. L., page 569); act April 30, 1864, section 7, (P. L., page 220); act April 21, 1855, section 17, (P. L., page 268); act March 30, 1859, (P. L., page 302); act June 11, 1879, section 2, (P. L., page 131); act February 14, 1881, section 1, (P. L., page 3); act April 21, 1855, sections 14 and 15, (P. L., page 267); act April 17, 1861, (P. L., page 354); act May 13, 1856, section 8, (P. L., page 569); act April 14, 1851, section 8, (P. L., page 591); act May 13, 1857, section 2, (P. L., page 489); act March 21, 1862, section 1, (P. L., page 152); act April 17, 1866, section 2, (P. L., page 969); act April 19, 1883, sections 1-13, (P. L., page 9); act March 28, 1814, (P. L., 1813-14, page 304); act June 26, 1885, section 1, (P. L., page 193); act February 3, 1824, section 1, (P. L., 1823-24, page 18); act February 2, 1854, section 11, (P. L., page 29); act April 19, 1883, section 6, (P.

L., page 11); act April 21, 1858, section 2 (P. L., page 385); act May 16, 1857, section 2, (P. L. page 549); act March 31, 1864 (P. L., page 171; act February 16, 1866, (P. L., page 50); act March 11, 1846, section 8, (P. L., page 115); act March 22, 1869, (P. L., page 477); act April 17, 1861, (P. L., page 354); act February 3, 1824, sections 7 and 8, (P. L., 1823-24, page 21); act March 11, 1846, section 1, (P. L., page 114); act April 16, 1845, sections 3-5, (P. L., page 496); act March 13, 1847, (P. L., page 340); act April 12, 1859, (P. L., page 543); act March 11, 1846, sections 2-6, (P. L., page 114); act April 21, 1858, section 9, (P. L., page 387); act January 23, 1849, sections 3-5, (P. L., page 686); act April 9, 1861, section 5, (P. L., page 269); act May 13, 1856, section 11, (P. L., page 569).

AMOUNT OF TAXES COLLECTED OR RETURNED FOR STATE PURPOSES FOR THE FISCAL YEAR ENDING NOVEMBER 30, 1899.

Tax on capital stock,	$4,567,962 24
Tax on bank stock,	550,310 17
Tax on gross receipts,	753,933 13
Tax on gross premiums,	42,354 18
Foreign insurance companies,	*646,774 75
Tax on loans,	1,295,120 01
Bonus on charters,	780,087 45
Tax on net earnings or income,	96,126 06
Tax on collateral inheritances,	933,575 01
Tax on personal property,	†2,764,258 48
Tax on writs, wills, deeds, etc.,	144,040 62
Mercantile licenses,	518,148 65
Wholesale liquor licenses,	448,686 74
Retail liquor licenses,	536,892 31
Brewers' and distillers' licenses,	244,235 19
Bottlers' licenses,	156,822 09
Billiard licenses,	42,466 25
Eating house licenses,	17,794 24
Brokers' licenses,	29,787 95
Auctioneers' licenses,	14,325 45
Peddlers' licenses,	1,296 70
Theatre, circus, etc., licenses,	18,582 66
Notaries public commissions,	22,150 00
Fees of public officers,	178,840 18
Total,	$15,804,570 51

*One-half this amount was returned to the treasurers of the several cities and boroughs of the Commonwealth, under section 2, act June 28, 1895, (P. L., page 410), to be used as a fund for the relief of disabled firemen.

†Three-fourths of this amount was returned to the several counties of the Commonwealth, under section 3, act June 8, 1891, (P. L., page 233).

AMOUNT OF TAXES COLLECTED FOR COUNTY, CITY AND BOROUGH PURPOSES, AS PER REPORT OF SECRETARY OF INTERNAL AFFAIRS FOR YEAR ENDING NOVEMBER 30, 1899, PAGES 384 AND 385.

County.	Amount.
Adams,	$26,127 60
Allegheny,	5,194,904 09
Armstrong,	60,947 15
Beaver,	86,637 16
Bedford,	26,840 13
Berks,	209,124 37
Blair,	406,950 47
Bradford,	74,030 28
Bucks,	94,259 62
Butler,	44,878 22
Cambria,	126,314 22
Cameron,	5,160 88
Carbon,	26,298 55
Centre,	61,372 17
Chester,	53,337 35
Clarion,	44,487 21
Clearfield,	73,140 99
Clinton,	44,568 71
Columbia,	44,812 89
Crawford,	142,626 62
Cumberland,	58,225 75
Dauphin,	102,720 82
Delaware,	143,575 63
Elk,	22,842 92
Erie,	297,327 92
Fayette,	118,966 65
Forest,	20,628 53
Franklin,	104,200 40
Fulton,	10,383 76
Greene,	24,574 85
Huntingdon,	38,107 45
Indiana,	53,599 15
Jefferson,	78,315 23
Juniata,	31,055 45
Lackawanna,	112,639 68
Lancaster,	197,248 50
Lawrence,	66,992 27
Lebanon,	43,451 96
Lehigh,	183,628 52

County.	Amount.
Luzerne,	128,673 41
Lycoming,	218,955 02
McKean,	52,273 66
Mercer,	46,443 88
Mifflin,	31,662 19
Monroe,	25,577 71
Montgomery,	112,678 99
Montour,	21,885 82
Northampton,	40,471 98
Northumberland,	146,407 40
Perry,	24,306 30
Philadelphia,	9,509,665 35
Pike,	13,466 64
Potter,	42,276 18
Schuylkill,	131,073 41
Snyder,	14,410 81
Somerset,	44,209 42
Sullivan,	4,296 00
Susquehanna,	57,728 04
Tioga,	76,233 69
Union,	19,224 75
Venango,	28,689 52
Warren,	35,319 35
Washington,	143,232 37
Wayne,	26,695 16
Westmoreland,	130,217 56
Wyoming,	22,135 27
York,	150,772 70
Total,	$19,854,226 70

NOTE.—From the amount collected in each county, as set forth in column number four, pages 384 and 385, of the Report of the Secretary of Internal Affairs, is deducted the amount collected on licenses of all kinds, as set forth in column number eight, of said report, and the amount of State tax on personal property returned to the Board of Revenue Commissioners for year 1899. On account of variation in figures, the amounts collected in a few counties have been taken from the detailed reports of counties found in said report of Secretary of Internal Affairs, pages 256-383. The amount given from Luzerne county is less State tax only.

AMOUNT OF LICENSES OF ALL KINDS COLLECTED IN THE SEVERAL COUNTIES OF THE COMMONWEALTH, PER REPORT OF SECRETARY OF INTERNAL AFFAIRS FOR YEAR ENDING NOVEMBER 30, 1899, PAGES 384 AND 385.

County.	Amount.
Adams,	$7,890 57
Allegheny,	1,227,359 50
Armstrong,	8,650 00
Beaver,	11,394 50
Bedford,	6,180 30
Berks,	141,589 50
Blair,	46,474 45
Bradford,	15,452 00
Bucks,	23,692 52
Butler,	7,705 50
Cambria,	64,279 00
Cameron,	4,750 00
Carbon,	31,568 50
Centre,	8,826 00
Chester,	15,812 50
Clarion,	9,620 00
Clearfield,	22,411 50
Clinton,	16,588 00
Columbia,	16,704 00
Crawford,	32,788 50
Cumberland,	10,094 17
Dauphin,	62,775 00
Delaware,	41,753 00
Elk,	12,971 00
Erie,	113,226 50
Fayette,	21,276 25
Forest,	1,911 90
Franklin,	9,984 84
Fulton,	854 00
Greene,	1,687 50
Huntingdon,	2,885 50
Indiana,	1,200 00
Jefferson,	11,026 50
Juniata,	2,620 50
Lackawanna,	194,251 51
Lancaster,	80,748 00
Lawrence,	15,922 00
Lebanon,	30,046 74
Lehigh,	80,086 00

County.	Amount.
Luzerne,	198,960 00
Lycoming,	55,965 55
McKean,	32,784 73
Mercer,	10,241 00
Mifflin,	3,979 00
Monroe,	9,324 50
Montgomery,	46,309 50
Montour,	11,365 80
Northampton,	70,052 95
Northumberland,	58,921 00
Perry,	6,185 50
Philadelphia,	2,727,902 31
Pike,	3,872 50
Potter,	3,274 00
Schuylkill,	209,221 50
Snyder,	5,321 00
Somerset,	8,968 00
Sullivan,	14,181 50
Susquehanna,	14,677 50
Tioga,	9,929 00
Union,	3,712 50
Venango,	16,121 00
Warren,	9,312 20
Washington,	18,865 00
Wayne,	13,857 00
Westmoreland,	39,306 00
Wyoming,	5,414 40
York,	44,247 00
Total,	*$6,067,833 51

*There was paid into the State Treasury during the fiscal year that ended on November 30, 1899, for mercantile, wholesale liquor and other licenses, per Auditor General's report for 1899, $2,029,038.23.

AMOUNT OF TAXES COLLECTED FOR SUPPORT OF THE POOR, PER REPORT OF SECRETARY OF INTERNAL AFFAIRS FOR YEAR ENDING NOVEMBER 30, 1899, PAGES 384 AND 385.

County.	Amount.
Adams,	$10,800 00
Allegheny,	313,297 45
Armstrong,	23,878 32
Beaver,	18,000 00
Bedford,	10,833 33
Berks,	55,895 56
Blair,	28,890 32
Bradford,	21,398 34
Bucks,	12,500 00
Butler,	27,903 71
Cambria,	27,432 13
Cameron,	6,340 17
Carbon,	27,611 24
Centre,	41,231 62
Chester,	36,317 63
Clarion,	26,882 19
Clearfield,	18,689 59
Clinton,	19,768 07
Columbia,	30,396 94
Crawford,	21,110 70
Cumberland,	12,000 00
Dauphin,	38,724 02
Delaware,	31,200 00
Elk,	22,965 00
Erie,	45,112 05
Fayette,	28,068 86
Forest,	7,130 90
Franklin,	15,108 10
Fulton,	2,377 42
Greene,	13,300 00
Huntingdon,	14,355 00
Indiana,	23,690 14
Jefferson,	30,007 87
Juniata,	14,530 28
Lackawanna,	120,307 23
Lancaster,	65,682 53
Lawrence,	23,238 13
Lebanon,	17,500 00
Lehigh,	32,023 18

County.	Amount.
Luzerne,	131,123 11
Lycoming,	50,153 44
McKean,	20,550 55
Mercer,	30,121 02
Mifflin,	3,484 50
Monroe,	12,117 36
Montgomery,	48,986 84
Montour,	8,776 43
Northampton,	21,500 00
Northumberland,	56,830 33
Perry,	8,776 94
Philadelphia,	500,978 83
Pike,	4,859 50
Potter,	21,644 52
Schuylkill,	114,394 00
Snyder,	9,218 36
Somerset,	7,526 54
Sullivan,	7,429 67
Susquehanna,	22,408 97
Tioga,	21,113 19
Union,	14,637 55
Venango,	13,634 66
Warren,	14,866 00
Washington,	22,150 00
Wayne,	18,617 99
Westmoreland,	39,000 00
Wyoming,	7,083 86
York,	35,000 00
Total,	$2,603,482 18

AMOUNT OF TAXES COLLECTED FOR SCHOOL PURPOSES, EXCLUSIVE OF STATE APPROPRIATION, PER REPORT OF SECRETARY OF INTERNAL AFFAIRS FOR YEAR ENDING NOVEMBER 30, 1899, PAGES 384 AND 385.

County.	Amount.
Adams,	$33,766 35
Allegheny,	1,667,255 34
Armstrong,	55,317 41
Beaver,	103,875 38
Bedford,	54,766 01
Berks,	273,779 57
Blair,	176,518 81
Bradford,	114,189 41
Bucks,	123,788 41
Butler,	91,120 55
Cambria,	188,068 36
Cameron,	15,580 30
Carbon,	69,028 88
Centre,	59,066 50
Chester,	181,105 61
Clarion,	42,839 39
Clearfield,	97,771 33
Clinton,	45,110 99
Columbia,	65,121 72
Crawford,	148,180 40
Cumberland,	72,891 50
Dauphin,	228,686 22
Delaware,	206,169 73
Elk,	63,250 00
Erie,	238,884 00
Fayette,	147,755 55
Forest,	24,882 33
Franklin,	72,640 61
Fulton,	8,131 72
Greene,	29,075 39
Huntingdon,	49,007 63
Indiana,	44,388 29
Jefferson,	59,396 02
Juniata,	15,965 07
Lackawanna,	475,406 33
Lancaster,	258,218 97
Lawrence,	96,561 51
Lebanon,	85,838 53

County.	Amount.
Lehigh,	177,950 27
Luzerne,	755,940 88
Lycoming,	138,211 39
McKean,	119,556 04
Mercer,	94,141 70
Mifflin,	25,911 92
Monroe,	28,005 46
Montgomery,	389,737 36
Montour,	18,347 54
Northampton,	210,856 01
Northumberland,	165,149 67
Perry,	26,652 52
Philadelphia,	4,214,049 37
Pike,	11,187 04
Potter,	52,032 55
Schuylkill,	332,199 75
Snyder,	12,539 21
Somerset,	55,251 83
Sullivan,	16,604 47
Susquehanna,	45,294 15
Tioga,	82,745 02
Union,	18,381 06
Venango,	116,341 70
Warren,	90,174 89
Washington,	147,620 46
Wayne,	48,475 58
Westmoreland,	249,683 54
Wyoming,	27,130 68
York,	159,050 88
Total,	$13,612,622 76

AMOUNT OF TAXES COLLECTED FOR CONSTRUCTION AND REPAIR OF STREETS, ROADS AND BRIDGES, PER REPORT OF SECRETARY OF INTERNAL AFFAIRS FOR YEAR ENDING NOVEMBER 30, 1899, PAGES 384 AND 385.

County.	Amount.
Adams,	$41,402 42
Allegheny,	1,477,750 13
Armstrong,	47,953 93
Beaver,	150,269 76
Bedford,	49,516 83
Berks,	267,570 27
Blair,	139,488 64
Bradford,	138,070 00
Bucks,	170,252 55
Butler,	116,699 40
Cambria,	133,852 38
Cameron,	19,641 59
Carbon,	35,738 29
Centre,	52,382 72
Chester,	205,516 83
Clarion,	49,865 32
Clearfield,	120,624 09
Clinton,	53,827 74
Columbia,	64,613 75
Crawford,	109,381 54
Cumberland,	70,397 98
Dauphin,	236,884 51
Delaware,	191,195 00
Elk,	53,600 00
Erie,	99,259 24
Fayette,	164,683 45
Forest,	21,367 05
Franklin,	51,703 30
Fulton,	9,535 02
Greene,	54,388 71
Huntingdon,	59,944 69
Indiana,	72,149 30
Jefferson,	77,680 74
Juniata,	19,750 07
Lackawanna,	63,558 23
Lancaster,	316,210 90
Lawrence,	55,079 51
Lebanon,	81,538 38
Lehigh,	62,667 92

County.	Amount.
Luzerne,	300,483 13
Lycoming,	85,797 83
McKean,	82,780 25
Mercer,	107,438 90
Mifflin,	29,359 81
Monroe,	32,692 23
Montgomery,	381,646 17
Montour,	13,084 58
Northampton,	135,968 20
Northumberland,	30,643 82
Perry,	36,018 36
Philadelphia,	3,343,783 92
Pike,	13,454 13
Potter,	56,802 69
Schuylkill,	214,657 69
Snyder,	23,958 72
Somerset,	59,971 70
Sullivan,	28,599 96
Susquehanna,	50,722 25
Tioga,	109,705 48
Union,	22,491 88
Venango,	114,325 39
Warren,	88,101 94
Washington,	207,220 07
Wayne,	54,032 20
Westmoreland,	240,207 22
Wyoming,	22,868 02
York,	218,699 78
Total,	$11,312,528 50

RECAPITULATION.

Taxes collected for State purposes,	$15,804,570 51
Taxes collected for county, city and borough purposes,	19,854,226 70
Licenses of all kinds collected,	6,067,833 51
Taxes collected for support of poor,	2,603,482 18
Taxes collected for school purposes,	13,612,622 76
Taxes collected for construction and repair of streets, roads and bridges,	11,312,528 50
Total,	$69,255,264 16

REPORT OF THE COMMITTEE ON ROADS AND ROAD LAWS TO THE STATE BOARD OF AGRICULTURE.

S. R. DOWNING, *Chairman.*

Harrisburg, Pa., January 23, 1901.

As the years go by, public sentiment in favor of solid roads increases. The growth of this sentiment is due, in large part, evidently, from agitation of the question at farmers' institutes and by its discussion in National and State bulletins sent out by our Agricultural Departments. Reforms, no matter how necessary to the public welfare, must be preceded by a vital, persistent, educational pressure. Thus time must elapse and the public suffer until the "eyes of the blind," as it were, are opened. Not many years ago few would consent to the public macadamizing of roads upon the sole objection that it would be raising the tax. Now the public have reached so far in the alphabet of the movement as to know of a certainty that if we do not sow we cannot reap, and that good roads are virtually dividend payers in the way of saving, not only in taxes, but in the economy of draft and time. And yet, notwithstanding that this light has been thrown about us by the insistent advocacy of what is for our good in the betterment of roads, and notwithstanding we may really know that money in solid roads over which we may not travel is equal to money invested for profit in building and loan associations, yet there are a multitude of instances where the citizens of townships object to the improvement of roads mainly for the benefit of the people of other townships.

To be definite, in township A the citizens refuse the improvement of a certain thoroughfare, although perhaps a State road, on the plea that few tax payers of township A use the road, whereas such road is a thoroughfare between townships B, C and D and the county town. The townships B, C and D have no remedy as against township A. The citizens of township A feeling that there is injustice in the matter, appeal to the grand jury for county aid. The county is

placed exactly in the position of township A. It refuses aid upon the plea that but a small minority of its citizens will reap the benefit of any outlay by the county. An instance can be cited of this "dead lock," as it were. A road extends out from Philadelphia twenty-two miles to a borough of about ten thousand population. This road is splendidly macadamized with the exception of two miles in one township and a half mile in another township. The county refused aid through the grand jury, one of the townships refused private aid to the sum of one-third the cost of the betterment, and again the supervisor of said township refused to permit the building of the road by contract unless a large part of the cost of the improvements in money was raised. The supervisor was evidently loyal to the will of his constituents in the matter; nor should we be disposed to reflect upon the citizens of the township. Evidently, legislation is needed in the case here cited that will justly equalize road taxation.

One of the townships cited adjoins the borough, north, south and east. This township has more travel to contend with than any other township in the county, and is gradually macadamizing all the approaches out from the borough. Although citizens of the county, south, east and west are using these roads abutting the town, the county refuses aid. There can be no compulsion in the matter. What shall be done to break this and kindred hindrances? Motor carriages from Philadelphia, rigs from Montgomery and Delaware counties pass over this thoroughfare, except when blocked by the two cited mud patches. Thus our county is disposed, if anything, to lay the burden on the State. Is not the county justified in this and would not State aid consistently solve the problem and remove the hindrance?

REPORT OF THE LIVE STOCK COMMITTEE TO THE STATE BOARD OF AGRICULTURE.

M. E. CONARD, *Chairman.*

Harrisburg, Pa., January 23, 1901.

Mr. Chairman and Fellow Members of the State Board of Agriculture:

Your Committee on Live Stock, beg leave to make the following report:

Pennsylvania has wonderful and almost unlimited resources, and not among the least is the live stock industry, which we think is

yet only partially developed in proportion to our natural facilities. Comparing our vast and fertile acreage with older countries enjoying no better advantages than we do, we find the results obtained by them so far surpass our feeble efforts as to make us bow down our heads in shame. Look at little Denmark, with one-third the area of Pennsylvania, keeping her two million cattle, feeding the epicures of the world with "gilt-edge" butter and cheese, while Pennsylvania buys more dairy products than she makes. And France, with her well regulated stud laws, controlling the selection of the sires of her horses, enabling her to produce a uniform grade and quality of horses that find a ready market at very remunerative prices awaiting them, whenever she has a surplus. Look at England and Scotland, who so fastidiously guard their sheep industry, which has come to them by inheritance through generations long since departed, and is now the envy of the whole world.

Do these countries possess any natural advantages that we do not? Is there anything there to surpass our own green hillsides and bountifully watered valleys? Can they raise foods that we cannot, that makes it possible for them to produce more and better horses, beef, butter or sheep than can be raised in Pennsylvania, where the best feed grows in abundance, and Yankee wit, perservance and ingenuity reign supreme? What country can produce a feed that will equal the corn plant, which yields such abundant crops upon our Pennsylvania farms? Then what is wanting that our grand old State should enjoy the same place in the markets of the world for live stock and its products that offer the greatest compensation to the producer?

It is upon live stock that all farming operations are based. Imagine a county, township, or even one farm where no animals existed,—what could be more nearly dead, desolate or stagnated. The animals make the market for the rough products of the farm. They are the manufacturing medium of the farmer and the fertilizing medium of the farm, and may be compared to the machinery of a mill or factory. For it is by reason of their presence that most of the crude products of the farm are converted into marketable products for human food. The importance of our domestic animals cannot be over estimated; nor can they receive much care and attention, for it is largely by their thrift we prosper.

While Pennsylvania possesses within her borders almost one hundred and fifty million dollars worth ($150,000,000) of live stock, your committee thinks that if more care and intelligence were practiced, an increase in the live stock population would result in a marked increase in the revenue. This population, and valuation thereof, as nearly as we could ascertain, is made up as follows:

788,000	horse @ $75,	$59,100,000
	(570,000 of these are kept and used on farms—over two-thirds of whole number.)	
61,167	mules @ $80,	4,893,360
	(39,000 of which are kept and used on farms, leaving only 22,167 to be used in mines, cities, etc).	
1,200,000	dairy cows @ $35,	42,000,000
750,000	steers, growing dairy stock and bulls @ $29,	21,750,000
830,000	sheep @ $3.90,	3,237 000
6,500	goats @ $3.50,	22,750
1,100,000	swine @ $7.61,	8,571,000
	Poultry, (we make no estimate of pigeons, hares, dogs and cats, which are not without value),	8,236,000

Considering horses and mules, it is evident that the farm teams of the State must either be a heavy expense to the agriculturist, or they might be a source of a handsome revenue besides the work that is expected of them in the regular routine of farm duties. The profit directly derived from our farm teams depends upon quality, and whatever source we look to for supply, and how they are treated and disposed of after the work is done. For want of definite information, it is hard to estimate what proportion of farm teams are produced on the farms where they are intended to be used; but we are inclined to think it is not so large as it should be; for in the sections of the State that possess the best natural facilities for horse raising, they depend almost wholly on shippers of western and southern horses for their supply, paying the outside cash value for very uncertain quality, instead of reaping a revenue from other localities for stock raised in excess of the home demand. And it is a lamentable fact that when colts are raised there is generally little or no attention paid to quality, adaptation of kind to work, and much less to selecting stock that will command the best prices in our city markets.

While we are well aware that a mixed husbandry is not suitable to all farmers, nor to all farms, we are of the opinion that if a careful study were made by each farmer or stock raiser, of just what he was best fitted for, and what his farm was best adapted to, there would be plenty of people found in Pennsylvania to raise all of our farm teams, and furnish a large part of those used in other cities besides, if not all. Or, if a definite and desirable type known to exist here, we would have no difficulty in finding export trade for our surplus, as does Denmark, in addition to her immense dairy industry. In short, we wish to suggest, or even insist, that when colts are raised there should be more attention paid to proper selection of kind for a definite

purpose. As soon as the very general custom of breeding the old, worn out or vicious mare to the lowest priced horse is abandoned, breeding will cease to be a lottery, and will be followed by regular and satisfactory results.

We have nothing to urge as to breeds. But we may say in passing, that location has much to do with the kind that should be raised, and that each breeder should consider carefully what breed is best adapted to his work and for his personal use. He will then find that he will be successful, no matter what breed he may select, for there is a ready market open for good horses of any kind, but they must be good to bring the highest prices.

The success or failure in raising even a well-bred colt, depends very largely upon the care and attention it receives during its growing years; at a time when its size, disposition, feet, legs, joints and even general conformation will yield to treatment received—be it good or bad.

Mules are taking quite a prominent place in the work teams of the State, and command quite good prices; perhaps more uniform than those for horses, and are quoted $5 per head higher. There have been quantities of mule colts six months to one year old shipped into this State from the south during the past year, and are being purchased by farmers for feeding purposes instead of cattle, at from $30 to $60 per head. We believe, if present prices continue a few years, these animals will yield a fair compensation for feed and care, as they generally find a more ready market than horses, and at much better prices.

The dairy cow is notably conspicuous in many counties, and her products throughout the entire State. She represents $42,000,000 and should yield returns in proportion. While many herds of cows are kept in Pennsylvania that yield a very satisfactory return for feed, care, etc., with a fair profit to the owner, it is a well-known fact that such herds are greatly in the minority; the large majority of the herds being managed in a careless, slip-shod, go-as-you-please manner, and of course not yielding a living profit to the owner. There are surely too many cows kept whose ability to produce marketable products is below the limit, which will insure a fair compensation for food consumed, and the care and labor bestowed. There are very few dairies to be found in which there is not a large percentage of animals kept at the expense of the more productive members therein. These must reduce the per capita production very seriously; very often, we think, below the cost of maintaining the entire herd. For this condition there are several causes assigned.

First, a lack of knowledge of the productivity of each animal; second, a lack of care of the entire herd; third, poor breeding; fourth,

the absence of a food ration that will produce the desired products, with the least possible waste. The best known methods of overcoming these difficulties are published free for the asking, in bulletin form by our Department of Agriculture both State and National, and we would urge the more general reading of these bulletins by our practical farmers, dairymen and stock raisers. If by a little better breeding, care, feeding and general selection, the dairy stock of this State could be made to produce one hundred quarts of milk per head more per annum than they now do, at two and one-half cents per quart, it would put into the pockets of the herd owners of Pennsylvania $3,000,000 annually; or nearly eight per cent. of the money invested in dairy cattle throughout the entire State. What could pay better and be easier done than to make a cow that gives 1,700 quarts of milk in one year (which we believe is the avereage yield), give less than one-half quart per day more, or 100 quarts per annum, by careful feeding and attention, stabling, breeding, and the like. In short, your committee wish to urge upon the dairymen of Pennsylvania the necessity of better breeding of dairy cattle, by the introduction of better bulls of known milk or butter strains or families into the herds, and more careful selection of the calves to be raised; a more thorough knowledge of the individual production of their cows; the benefits to be derived from more careful feeding and general stable care; and the vast importance of preparing the product for market in the best possible manner. We are also of the opinion that it would be more profitable to raise the stock with which to replenish our dairies, rather than purchase cattle shipped into our State that have been sold for reasons that make them objectionable members for us to add to our herds. If our 1,200,000 cows would produce one-half as many heifer calves and one-half of them should be raised, we could produce in Pennsylvania alone 150,000 cows annually, or six times the number now brought here from other States, which would turn the current of the cattle trade in the opposite direction, with an increased revenue to the State.

The sheep industry represents in Pennsylvania $3,237,000, and is very much scattered over the State. Near the markets, a few flocks are kept for the production of early lambs, yielding a very fair profit; but we are informed that the greater number of sheep are kept in counties more remote from earlier markets, for the production of wool and mutton. The greatest difficulty in the way of the sheep industry is the lack of protection against the inroads by dogs. There have been numerous efforts made to protect them by taxation of dogs, which only results in compensation for animals killed or injured, but does not restore the flock to its normal, thrifty condition. We would suggest that the taxes on dogs be so arranged as to favor the spraying

of all females not kept expressly for breeding, and also the castration of all males not kept for breeding purposes. This could be done by making the tax very heavy on entire animals and very low or nothing on emasculated animals. We think the result would be the keeping of very much fewer dogs, and such as were kept would either be of more harmless character or would be more closely looked after.

The pork industry has become almost a by-product of the dairy, as milk, whey, and the like, enter very largely into their ration. It now represents $8,571,000, and if the dairy stock were increased to our possible limit, the sales of Pennsylvania bacon would soon become a prominent feature in our markets. As it is, we only supply a small percentage of what is consumed in our State. Since it is an established fact that the price of grain and the price of fat hogs are almost universally harmonious, would it not be to our advantage as farmers and stock raisers to give more attention to the production of pork, and more study to their habits and requirements; also to the diseases and ailments that have caused so much loss and disappointment in the past; and learn how, by preventing or combating such conditions, to make the pork industry one of large income and profit.

The report on poultry we leave to the committee appointed for that purpose.

The reports upon the diseases of live stock throughout the State, by Dr. Pearson, of the State Live Stock Sanitary Board, show the effectiveness of the thorough work done by the Board, in a very marked reduction of the amount of disease existing among live stock of all kinds; and your committee wish to call the special attention of this Board to their work, not only in suppressing disease but in the line of research and investigation; placing in the role of controllable or preventable diseases, many maladies that were heretofore not well understood, and the prevention of which was not attempted. We refer to tetanus, cerebro-spinal meningitis, abortion, hydrophobia, etc. We are creditably informed that when the work of eradicating tuberculosis by the application of the tuberculin test was first effectually begun in 1896, that 23 per cent. of all known diseased herds responded to the test; while now there is in the same class of herds only 11 per cent. of reaction; showing that by the persistent application of the test and the careful guarding of the State from the dumping of tuberculous animals from other States, by means of the inter-state law, we may yet reduce the percentage of tuberculous cattle to a very low point.

Hog cholera, which in 1897 caused a loss to the farmers of Pennsylvania to the amount of $400,000, has since been so reduced as to only cause during the past year a loss of about $50,000. This marvellous result is due, we believe, to a more thorough knowledge of the dis-

ease and to more intelligent inspection of pens, yards and cars where the diseased animals were kept or shipped, which is evidence of the advantage to be gained by knowledge of the environment, habits and tenacity of the disease germs we have to combat, and of the proper antiseptic to be applied for their prompt extinction.

Now since it is well established fact that the success of the agriculturist depends very largely upon its products, your committee wish to urge upon this body the importance of distributing such information amongst the farming people as will lead to the better care, feeding and breeding of our live stock, and of exerting our efforts to prevent the present custom of buying our supply of farm animals from sources of uncertain reliability; but instead, produce a surplus, and change the present loss into a sourse of revenue.

THE ROAD PROBLEM.

AN ADDRESS BEFORE THE INTERNATIONAL GOOD ROADS CONGRESS, BUFFALO, SEPTEMBER 16, 1901.

BY HON. ANDREW PATULLO, *Ontario, Canada.*

Mr. Chairman, Ladies and Gentlemen, Fellow-Citizens of this Great North American Continent:

Meeting as we do this morning in this beautiful building dedicated to sacred song, where the masters of music during the memorable days of this memorable year have been interpreting for you the divine harmonies of the world, we come together to consider a very plain and practical question, a subject on which I fear I shall have some difficulty in interesting you, a question which I fear the ordinary citizens of your country and mine deem of little interest, but which is one of the great problems of the day. This association, of which Colonel Moore is the president, has been doing a work which some people at least in this country appreciate, and which in after years, I believe, will be appreciated by all the people of this great nation.

We are now in the beginning of a new century. We think this an age of progress, of marvelous invention and advancement; but it is anextraordinary fact that away back in the distant ages, the Romans were able to make good roads, and did make goods roads, on scientific principles. And even on this hemisphere, centuries ago the original

inhabitants of South America were great road builders. There still exist in South America, monuments of their skill and genius. During the Middle Ages the making of good roads seems almost to have been forgotten. It is only with the beginning of the last century, with the advent of Macadam and Telford, that the people of Europe began to make good roads. But what a marvelous effect those good roads have had in England, in Germany, and in France upon the progress of those countries. I have no hesitation in saying that Telford and Macadam, and their coadjutors who taught the people how to make good roads, contributed as much to the social and material progress of the world as did Stephenson, who invented the steam engine, because the prosperity of the British Isles, the prosperity of Belgium (whose representative is here to-day), the prosperity of France, and other European countries has depended not alone upon railroads and other large means of transportation, but upon the common highways of the people.

Those of you who have not been in those old lands can scarcely realize not only the beauty of the landscape, but the perfection of the rural roadways, which have contributed largely to the prosperity and wealth of the people. The French peasants are very poor, as compared with you; but after their great war these peasant proprietors of France were able to take up a great part of the national loans. One of the chief factors making for their prosperity is the perfection of the rural roads. Let me illustrate the difference between their roads and the roads of this country. One of your eminent fellow-citizens, Mr. James Gordon Bennett, was able, some years ago, to drive a coach and four along the roads of France 144 miles in ten hours. What would become of a coach and four driven over the rural highways of this great country in that way? [Applause and laughter.] How is it that you who have made such marvelous progress in invention, in industries, in commerce, who are going ahead by leaps and bounds, in many parts of the country, have scarcely emerged in the matter of road building from a semi-barbarous condition? There are, of course, in the State of New Jersey, in Massachusetts, and in the great State of New York, some beautiful roads; and wise and sagacious men have secured some good laws, at least in reference to this great question. But these places are the little oases in the great desert of inefficiency, ignorance, and incompetency under which the common highways of the country, as well as the streets of your cities and towns, have been built during all those years. I do not hesitate to say that through the lack of education, the lack of organization and the lack of method, from 10 to 25 per cent. of the vast sums of money spent in the cities of this country on streets and pavements has been thrown away; that from 20 to 50 per cent. of the

millions of days' labor and the millions of dollars that have been spent in the rural districts of the United States might as well have been thrown into the sea. Is not that an appalling fact? But you all realize it. I state a fact to show you the vast importance of this question. It has a direct bearing upon your public expenditure, upon your material progress.

Let me illustrate it in this way: This is a day of specialization as well as of marvelous advancement. You are specializing in everything; you are reducing everything to a science. If you had conducted the commercial enterprises of your cities on the same principles as the common roads of the country are conducted, how long would the business houses of this city or any other city stand? You put every industry, every business, into the hands of specialists, while you put the road making of the country into the hands of the incompetent and those who know nothing whatever about the principles of road making. Similarly handled, no new industry in this country would have the least chance of success. Your railways are managed by great men, by men of skill and genius; every department works with mechanical perfection. If the railways were managed as the rural highways are managed, and the streets in many of your cities, traffic would be paralyzed, and the wealthiest of these corporations made bankrupt. I venture to say that if the great Steel Trust of this country were to manage its business as we do our road making, within three years every shareholder in that corporation would be bankrupt. [Applause.] Surely, when you have made such progress in the arts and sciences, in commerce, industry and invention, you are able to organize the forces of the country in order to improve your streets and chief rural highways.

It is sometimes thought that in agitating the making of good roads, we are urging the expenditure of vast sums of money. We are not doing anything of the sort. It is not a question of any new expenditure. The expenditure is being made now. It is a question of economy. It is a question, not of throwing money away, but of saving the incalculable loss there now is in the industries of the country. Let me illustrate it in this way: I have been officially connected with the cheese industry in Canada, where we make from $20,000,000 to $25,000,000 worth of cheese a year. And, by the way, when we go to your expositions we generally take from 90 to 100 per cent. of the prizes. [Laughter and applause.] Now I believe that we are losing in haulage in connection with the cheese industry of Canada, at least $1,000,000 a year. Apply that to your incalculably greater output of grain and wheat and other products, and the wealth of Crœsus is a trifle in comparison to the loss that the people of the United States are sustaining every year by having bad roads where they could easily have good ones. [Applause.] Our appeal to you is that after

you have solved the great question of transportation in relation to your canals, in relation to your steamships, in relation to your great railways, you solve the equally important branch of the transportation problem which embraces the common highways of the country. Of what importance is it if the great arteries of commerce be perfect, if the little veins leading to them be not also perfect? What matter it if you cheapen the rate from the railway station to Liverpool, if it costs as much to get grain from the farm to the station as to take it from the station to the great markets of the world? There is the problem of road making in a nut shell. [Applause.]

But beyond these material and economic considerations there are many phases of this question affecting the social as well as the material well-being of the people. The most sagacious men of the present day, the thinkers, the acute observers, see many dangerous tendencies in this age of marvelous progress. One of the dangers is that the boys and girls are leaving the farm and going into the towns and cities. What is to become of the world when many of our great cities are ten times as great as they are now? It is true that the trolley is to some extent dispersing population, but only in a suburban way. I believe that in this question of road improvement lies the solution to a great extent of this difficult problem. In those old lands, to which I referred, the love of rural life is far more highly developed than it is in this country. In England, in Scotland, in France, and in Germany, when men become wealthy they are anxious to get out on the farm rather than into the cities. One reason for that is found in the beauty of the landscape, the beauty of the roadways and the roadsides. It is very different here. An English poet anticipated what we see in this country to-day when he said:

Ill fares the land, to hastening ills a prey,
Where wealth accumulates, and men decay.

Wealth is accumulating in this country with marvelous rapidity, but men are deserting the farm. You ought to turn them back. But if you want to keep the intelligent, brainy boys and girls of the country upon the farm instead of bringing them into the towns and cities amid the glare of the gaslights and the dangers of city life, you will assist us in this great movement, which means not only the making of highways, but the beautification of the roadsides and the rural homes of this great country of yours. [Applause.]

And now, having endeavored to show or to suggest the importance of the good roads problem, the enormous economy of good roads, the incalculable loss through bad ones, to suggest the many sides and phases of this vast problem of transportation—affecting, as they do, the social as well as the economic well-being of the peo-

ple; let me for a moment draw your attention to another, to what I may call a national and international consideration. You in this country, like ourselves across the line, have been having unexampled prosperity of late. The wheels of industry have been running fast. It will not always be so. Stagnation will come, and with it distress and social disturbances. In the olden days in other lands the cure which wicked rulers sometimes sought for social disturbances was foreign war. There is little fear, I trust, that your rulers will ever seek such a remedy, for the lives of a long line of great and good Presidents have made it improbable that any but a good man shall ever fill the position of Chief Magistrate of this nation. [Applause.]

We are dealing with a problem of transcendant national and international importance. If all the men and the millions engaged in that greatest of all conflicts in your history could have been engaged in improving the highways of the country, how much better it would have been for this fruitful land to-day. And so we suggest to the government of these great States that when men in this land of varied resources ask for work they need not be without bread. Let your governments spend the millions, the tens, the hundreds of millions which in other lands have been wasted in war in the promotion of local improvements. Without displacing a day's labor in any branch of industry, every unemployed man in the country could be given work on your streets and highways. This would be no charity, from which manly men shrink. It would yield you dividends a hundredfold in the profits on agriculture and every branch of commerce and industry dependent upon it. And beyond this you would find a remedy for another ill, worse and harder to eradicate than the misfortune of poverty.

Instead of soup kitchens for the unemployed, give them honest labor. Instead of wasting your resources in watching the lawless element in your cities, or in keeping it in idleness in your jails, offer it on public works, on national highways, the alternative of labor or the lash. [Applause.] I submit with all seriousness that in the development of the municipal, State, and national highways, in the improvement of the streets of your cities, there is offered to you the easiest, the wisest solution of some of the great and difficult problems that confront you. And it is a solution that does not involve the throwing away of money, but its wise investment. It is expenditure which, while curing social and national ills, will yield you an ample economic return. [Applause.]

I have attended four great conventions in this country on behalf of good roads. We are only beginning to attract attention. But don't suppose that, because you don't see much about our work in

the press, good work is not being done. I believe that a work has been taken up by such men as Hon. Martin Dodge, Colonel Moore, and their coadjutors which will spread over all the continent and in time transform the streets and rural highways of this and my own country. We have had eminent men here, and although their utterances in this congress may not have excited as much interest or been given as much space in the press, perhaps, as some current incident of minor importance, yet they are doing a great and glorious work. I come here representing the Good Roads Association of my own country to show that in everything you do for the well-being of the people of this great Republic, we Canadians, we Britons, are heart and soul in sympathy with you. [Applause.]

THE AGRICULTURAL SEED SUPPLY OF PENNSYLVANIA.

A CO-OPERATIVE INVESTIGATION BY THE PENNSYLVANIA STATE DEPARTMENT OF AGRICULTURE AND THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION.

BY PROF. GEO. C. BUTZ, *State College, Pa.*

The low prices of farm products and the considerable competition of western farmers are forcing the eastern farmer to look closely to his methods, and to mend his ways, in order that he may economize in expenses and increase his yields and that his profits may continue to encourage his honest labors. Far from insignificant is the fact that in the purchase of farm seeds, he is often paying dearly for lifeless seeds, weed seeds and even sand and other dirt that can contribute nothing to the farm but a poor grade of fertilizer.

In view of the importance of the subject and of our lack of knowledge of the quality of the agricultural seeds in the markets of Pennsylvania, the following investigation into the conditions of the seed markets of the State has been conducted in co-operation by the State Department of Agriculture and the Experiment Station.

Similar investigations by the United States Department of Agriculture and the Experiment Stations have shown that no complaint can be made against the established seed houses where every care is exercised to have seeds *pure*, *viable*, and *true to name*, but there are many careless and unscrupulous dealers handling untested seeds, in the purchase of which the farmer unwittingly pays an enormous price and then at harvest time he wonders why the Lord gave him weeds instead of clover.

Perhaps the seed merchant is not wholly to blame for the fraud perpetrated, since it is very likely he himself is not aware of the inferior character of the seeds he is selling, and at present the annoyance lies wholly with the farmer. Before purchasing, he must test the seed or have it tested by a reliable authority, or, he may require a guarantee of the standard of purity and germination and have the seed tested later. He should be willing to pay what good seed is worth and beware of *very cheap* seeds. In some States, legislation has been enacted to prevent gross fraud in the sale of seeds, but as yet no State has attempted a system of seed control upon the basis of the fertilizer control so effectual in this State. In 1897, the Legislature of the State of Maine enacted a law entitled "An act to regulate the sale of agricultural seeds." This act makes it the duty of the Director of the Experiment Station to prescribe the methods to be used in examining seeds, and to "publish equitable standards of purity together with such other information concerning agricultural seeds as may be of public benefit." There is no attempt here at seed inspection and hence the effect of the law in the way of *regulating* the sale of seeds is very slight.

COLLECTING THE SAMPLES.

To fairly test the seed supply of Pennsylvania, it was proposed to secure samples of the chief agricultural seeds directly from the merchants where the farmers are accustomed to buy their supply; and, accordingly, the Secretary of Agriculture authorized a reliable agent in every county of the State to take fair average samples of the following kinds of seeds and in the quantities indicated:

Kentucky blue grass,	½ oz.
Timothy,	½ oz.
Orchard grass,	½ oz.
Red clover, medium,	1 oz.
Red clover, mammoth,	1 oz.
Crimson clover,	1 oz.
Alsike clover,	1 oz.
Onion, Yellow Globe Danvers,	½ oz.
Cauliflower, Dwarf Erfurt,	¼ oz.
Sweet corn, Stowell's Evergreen,	½ pint.

Each quantity was placed in an envelope provided for the purpose, properly labeled and sealed by the agent and forwarded to the Experiment Station at State College, Pa.

The agents selected for this purpose were members of the State Board of Agriculture and certain other agriculturists who have been in close touch with the Department of Agriculture. There were collected in this manner 243 samples of seeds from 12 counties of the State, distributed as follows:

County.	Collector	Address.	Number of Samples.
Allegheny,	J. R. Orr,	Pittsburg,	36
Berks,	H. G. McGowan,	Geiger's Mills,	50
Bucks,	G. W. Row,		17
Cambria,	J. J. Thomas,	Carrolltown,	14
Cumberland,	D. B. Biggs,	Shippensburg,	8
Dauphin,	S. F. Barber,	Harrisburg,	18
Erie,	A. L. Wales,	Corry,	21
Fayette,	J. M. Hantz,	Merrittstown,	11
Lackawanna,	H. W. Northup,	Glenburn,	22
Northampton,	Wm. F. Beck,	Nazareth,	12
Venango,	W. J. Magee,	Oil City,	6
Warren,	R. J. Weld,	Sugar Grove,	25

These samples represent 57 different merchants in 23 different towns, and, so far as is known, the seeds were grown in one of the following States: Pennsylvania, New York, Ohio, Maryland, Indiana, Illinois, Michigan or California.

It will be seen in the tables that follow that with the seeds requested came some samples of white clover, alfalfa and millets.

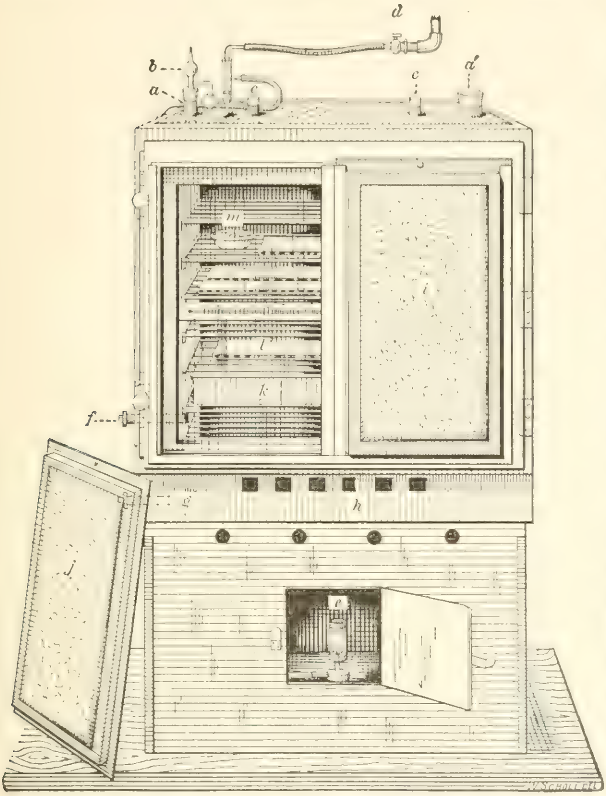
THE METHOD OF CONDUCTING THE TESTS.

The work of testing the samples of seeds was performed according to the rules adopted by the Committee of the Association of American Agricultural Colleges and Experiment Stations, January 23, 1897. Every sample was taken by the authorized agent of the Department of Agriculture and sent in packages provided for the purpose, directly to the Experiment Station. Each package bore the name of the seed, its reputed age and selling price, also the name of the merchant, and the name of the agent taking the sample.

The weights of the samples were in every case greatly above the minimum quantities stipulated in the above rules for making purity tests. Foreign seeds were taken from the entire sample by spreading the seeds over white paper, and picking out the weed seeds with the use of forceps and a magnifying glass.

For the germination tests 200 seeds of each sample were taken indiscriminately from the pure seed, and duplicate tests were made simultaneously. In the case of the corn, but 100 seeds were used in accordance with the aforesaid rules.

The germinating apparatus used for this work is the standard seed germinating chamber used by the United States Department of Agriculture and the American Experiment Stations, in which the conditions of moisture and temperature can be most perfectly controlled. The sub-stratum or seed bed was a blue blotting paper which was kept well moistened during the germination tests; the temperature was maintained almost uniformly at 70 degrees, F.



STANDARD GERMINATOR.
By courtesy of U. S. Dept. of Agriculture.

Records were made of the germinations every day except Sabbath days and every sample was permitted to remain in the germinator fourteen days.

The Kentucky blue grass seed was germinated in seed pans of sand in the greenhouse, giving the seed the lightest possible covering of sand that was previously washed and passed through a sieve of small mesh. The duration of these tests was 30 days. All seeds that fell short of the standards were tested a second time and the larger results only are reported.

At the head of the tables in this report are given the standard percentages of purity and germination fixed by the United States Department of Agriculture after many thousand tests had been made. Several reputable seed houses have been willing to guarantee such percentages in the seeds they sell, and it may be seen from the results given in the following tables that they are not too exacting of the seedsmen and not more expensive for the farmer.

The net value or agricultural value of a sample to a farmer is indicated in the tables in the column headed the "per cent. of pure,

germinable seed," and is obtained in each case from the figures of "per cent. purity" and "per cent. total germination," by multiplying the former by the latter figure and dividing by 100. In other words, if 98 per cent. of a sample is pure seed and of this only 90 per cent. germinates, then there is in the sample only 90 per cent. of 98 per cent., or 88.2 per cent. of pure germinable seed. If our sample is red clover seed costing $6.00 per bushel, we are paying for a bushel of pure germinable seed $6 × 100 ÷ 88.2 = $6.80. It is clear, therefore, that if the purity or germination runs low, the cost of the good seed in the sample mounts very high.

RED CLOVER.

Thirty three samples of Medium Red Clover were examined. Of these, only three fell below the standard of purity and five below the standard of germination. In one case (No. 241), the purity was high but the germination only 22.8 per cent. This was undoubtedly old seed; the bright, fresh color of new seed was wanting. The germination test was repeated in soil in the greenhouse with but one per cent. of germination after many days. The purchase of such seed, therefore, at best would cost the farmer $22.12 per bushel of good seed, and this according to the soil test would give, under average conditions, exceedingly poor results. The market price is no indication of the true value of the seed. The prices ranged from $4.75 to $6.60 per bushel and the cost of the pure seed ranged from $5.23 to $22.12 (or $8.68, by dropping the one sample of undoubtedly old seed). While we should beware of cheap seed, it is remarkable that sample No. 238, with the lowest selling price ($4.75), is in fact the cheapest in cost of good seed, $5.23.

The impurities were usually weed seeds, consisting mainly of Green Foxtail Grass, Lady's Thumb, Ribgrass and Docks. The Clover seed is remarkably free from mechanical impurities.

RED CLOVER.

Character and Cost of the Seeds on the Market. Standard of Purity, 98 Per cent. Standard of Germination, 85-90.

Number of Sample.	Per cent. pure seed.	Per cent. germination in five days.	Total per cent. germination in fourteen days.	Per cent. of pure germinable seed.	Selling price per bushel.	Number of foreign seeds in one pound of sample.	Cost of pure germinable seed per bushel.
4,	99.8	87.8	91.5	91.3	$5 00	1,250	$5 48
5,	99.8	85	89.7	89.5	5 80	420	6 48
19,	99.2	86.8	90	89.3	5 50	210	6 16
24,	99.0	86.8	91.5	90.6	6 00	2,668	6 62
34,	99.5	91.8	94	93.5	6 50	728	6 95
38,	98.2	87.8	92.3	90.6	5 75	6,666	6 35
45,	99.8	88.5	91.3	91.1	6 00	68	6 59
50,	99.1	72.5	74.8	74.1	6 25	2,533	8 43
55,	97.8	88	91.3	89.3	6 00	7,238	6 76
59,	99.5	72	75.3	74.9	6 50	1,225	8 68
70,	96.8	69.3	71.8	69.5	5 25	4,385	7 55
76,	99.2	85.8	90.3	89.6	5 25	2,842	5 86
92,	100	81.8	84.8	84.8	5 75	49	6 78
102,	100	90.5	94.3	94.3	6 60	15	7 00
105,	97.8	90	93	91.0	6 00	3,640	6 59
119,	99.9	85.3	90.3	90.2	5 75	264	6 37
121,	98.2	85.5	88.8	87.2	5 40	2,357	6 19
138,	98.0	83	88.3	86.5	5 50	6,006	6 36
150,	99.8	87.5	89.5	89.3	5 60	266	6 27
152,	100	83.3	88.8	88.8	5 75	23	6 59
159,	99.9	87.8	91.5	91.4	5 50	312	6 02
166,	99.1	76.3	78.5	77.8	6 00	817	7 71
175,	99.5	89	90	89.6	5 50	1,563	6 14
179,	99.6	91.5	93.8	93.4	5 50	192	5 89
186,	99.5	82.8	85.5	85.1	5 50	882	6 46
206,	99.9	87.5	90.3	90.2	5 00	256	5 54
207,	99.5	82.8	87.3	86.9	5 10	1,404	5 87
223,	99.7	94.3	96.8	96.5	6 00	1,053	6 22
225,	99.5	74.5	82	81.6	5 75	1,301	7 05
238,	100	88.8	90.8	90.8	4 75	130	5 23
239,	99.9	84.8	89.5	89.4	5 50	270	6 15
241,	99.1	20.3	22.8	22.6	5 00	2,376	22 12
243,	99.8	86.8	90.3	90.1	5 75	215	6 38

RED CLOVER.

Number and Character of Foreign Seeds in a Pound of Each Sample.

Number of Sample.	4.	5.	19.	24.	34.	38.	45.	50.	55.	59.	70.	76.	92.	102.	105.	119.	131.
Green Foxtail,	1,250						17		704		975			15	[illegible]	[illegible]	117
Yellow Foxtail,					42		16										
Lady's Thumb,			120	134			35	68	104	35	[illegible]		12		[illegible]		[illegible]
Engel's Plantain,			90														
Ribgrass,		42		17	[illegible]			2,780	88	1,197	[illegible]	[illegible]	12		[illegible]	48	[illegible]
Pursh's Plantain,					56			17			316						
Sheep Sorrel,									1,056		136				11		16
Curled Dock,																	
Willow-leaved Dock,						66		68	352	23	412	12	25		[illegible]		
Tumble-weed,				17					836						[illegible]		[illegible]
Heal-all,						6,600											
Meadow Fescue,				2,500													
Finger Grass,															[illegible]		34
Witch Grass,															[illegible]	12	92
Spotted Spurge,																12	
Ragweed,																	276
Lamb's Quarters,																	
Wild Peppergrass,																	
Barnyard Grass,																	
Timothy,									4,048						480		
Total Foreign Seeds in One Pound,	1,250	420	210	2,668	728	6,666	68	2,633	7,228	1,225	4,385	2,842	49	15	[illegible]	261	2,377

RED CLOVER.

Number and Character of Foreign Seeds in a Pound of Each Sample—Continued.

Number of Sample.	133.	150.	152.	159.	166.	175.	179.	186.	206.	207.	223.	225.	238.	239.	241.	243.
Green Foxtail,	1,540	...	...	130	66	312	36	...	64	108	90	405	7	13	2,295	43
Yellow Foxtail,	[illegible]	...	...	52	...	...	...	54	...	...	45	...	...	...	...	...
Lady's Thumb,	[illegible]	[illegible]	23	52	49	68	36	...	32	54	...	43	67	31	...	54
Bracted Plantain,	...	...	...	...	...	...	...	36	32	324	450	324	13	94	...	22
Ribgrass,	[illegible]	[illegible]	...	...	111	...	...	720	...	675	315	378	...	94	81	43
Parish's Plantain,	[illegible]	...	...	...	...	...	...	...	...	54	[illegible]	...	...	6	...	[illegible]
Sheep Sorrel,	22	...	...	...	19	435	18	...	...	27	...	...	...	6	...	...
Curled Dock,	...	...	...	72	33	87	18	72	64	135	135	65	13	[illegible]	...	[illegible]
Willow-leaved Dock,	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tumbleweed,	...	95	...	26	16	52	...	...	...	...	9	5	...	13	...	11
Healall,	...	...	...	...	...	...	...	...	...	27	...	...	...	...	...	5
Meadow Fescue,	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Finger Grass,	[illegible]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Witch Grass,	[illegible]	...	...	...	...	...	...	...	...	...	...	54	...	...	...	11
Spotted Spurge,	...	...	...	...	...	...	...	...	32	...	...	...	...	...	...	...
Ragweed,	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Lamb's Quarters,	...	...	...	...	...	[illegible]	24	...	32	...	...	11	...	...	...	...
Wild Peppergrass,	...	...	...	...	490	...	...	...	...	...	...	...	...	...	...	...
Barnyard Grass,	...	...	...	...	...	...	...	...	...	...	...	16	[illegible]	...	...	...
Timothy,	[illegible]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5
Total Foreign Seeds in One Pound,	6,006	206	23	312	817	1,563	192	882	256	1,404	1,053	1,301	130	270	2,376	215

MAMMOTH RED CLOVER.

There were eighteen samples of Mammoth Red Clover sent for tests. They were, in general, fully up to the required standards in purity and germination. In a few samples the impurities consisted of dead seeds, broken stems and other dirt in quantities too great to be acceptable at the prices charged. The weed seed impurities were much the same as in the Medium Red Clover. Two samples were absolutely clean of all impurities, and yet the prices of them were only the average market price of good seed, that is, $5.75 and $6.00 respectively. In several instances the dull color of the seed was noticeable, indicating old seed, and the germination of such samples sustained the diagnosis in each case. The range of prices of Mammoth Clover was not so great as of the Medium Red, as no samples of suspiciously cheap seeds were submitted. In consequence of this, the cheapest samples of the table below were the cheapest seeds to buy in point of good seeds.

White Clover. Though uncalled for, two samples of White Clover were received and the results of their tests are given. In one case the purity and germination both drop below the standards required, and though the selling price was one dollar cheaper than the other sample, the cost of pure germinable seed was seventy-three cents per bushel greater.

Alfalfa. Two samples of alfalfa were also received and submitted to tests. Their color was not as bright as fresh seed usually bears and their germination was much below the required per cent. Alfalfa is but little used in Pennsylvania and the seed is likely to be held over by unscrupulous dealers.

MAMMOTH RED CLOVER.

Character and Cost of the Seeds on the Market. Standard of Purity, 98 Per cent. Standard of Germination, 85-90 per cent.

Number of Sample.	Per cent. pure seed.	Per cent. germination in five days.	Total per cent. germination in fourteen days.	Per cent. of pure germinable seed.	Selling price per bushel.	Number of foreign seeds in one pound of sample.	Cost of pure germinable seed per bushel.
17,	99.1	73.8	76.5	75.8	$6 00	1,446	$7 92
31,	100	84	89.3	89.3	6 00	33	6 72
39,	99.5	91	94.3	93.8	6 00	806	6 40
43,	99.9	82	88	87.9	6 25	168	7 12
49,	99.6	69	70.8	70.5	6 50	1,170	9 22
54,	99.9	94	96	95.9	6 00	266	6 26
58,	99.0	76.8	79.5	78.7	6 75	2,959	8 58
69,	98.0	63.3	65.8	64.5	5 50	6,431	8 53
75,	97.4	87.3	90.8	88.4	5 25	1,120	5 94
84,	95.6	88	89.8	85.8	5 50	504	6 41
85,	95.1	91	93	88.4	6 75	14,000	7 64
86,	100	90.5	90.5	90.5	5 75	0	6 35
90,	99.4	88.3	90.5	90.0	6 25	425	6 94
93,	99.8	86	89.8	89.6	5 75	169	6 42
120,	99.2	85.5	89.3	88.6	6 00	632	6 77
151,	97.1	86.8	91.5	88.8	5 25	3,800	5 91
174,	87.0	85	85.8	74.6	5 60	672	7 51
181,	98.2	87.8	89	87.4	5 75	1,332	6 58

MAMMOTH RED CLOVER.

Number and Character of Foreign Seeds in a Pound of Each Sample.

Number of Sample.	17.	31.	39.	43.	49.	54.	58.	69.	75.	84.	85.	86.	90.	93.	120.	151.	174.	181.	White Clover. 163.	White Clover. 168.	Alfalfa. 96.	Alfalfa. 208.
Tumble-weed,	165	11				25		667					17	46			192	12	104			
Sheep Sorrel,	[illegible]		656			50				28							96	480	5,200	1,350		
Willow-leaved Dock,	311	11	78	126	[illegible]	132	88	3,497	56	112				77					104			
Bracted Plantain,	27				40		8										32					
Ribgrass,	[illegible]	11			1,600		2,640	667	1,070						27	500	96	26				
Lady's Thumb,	231			42	80		88	1,600		196			119	46			64	60		18		
Timothy,	231		78							168						3,200			7,800			192
Yellow Foxtail,	75						33															
Lamb's Quarters,							22											360	2,400	2,270		
Heal-all,									11													
Green Foxtail,											14,000		289		550		32	204				
Spotted Spurge,															55							
Curled Dock,																	160	180				
Clover, Red,																			2,600		2,880	
Alsike,																						32
Total Foreign Seeds in One Pound,	[illegible]	33	[illegible]	168	1,170	266	2,950	6,121	1,120	504	14,000	0	425	169	632	3,800	672	1,332	18,408	3,618	2,880	224

WHITE CLOVER.

Character and Cost of the Seeds on the Market. Standard of Purity, 95 Per cent. Standard of Germination, 75-80 Per cent.

Number of Sample.	Per cent. pure seed.	Per cent. germination in five days.	Total per cent. germination in fourteen days.	Per cent. of pure germinable seed.	Selling price per bushel.	Number of foreign seeds in one pound of sample.	Cost of pure germinable seed per bushel.
163,	94.0	48.3	73.8	69.4	$9 00	18,408	$12 97
168,	99.0	38.3	82.5	81.7	10 00	3,618	12 24

ALFALFA.

Character and Cost of the Seeds on the Market. Standard of Purity, 98 Per cent. Standard of Germination, 85-90 per cent.

Number of Sample.	Per cent. pure seed.	Per cent. germination in five days.	Total per cent. germination in fourteen days.	Per cent. of pure germinable seed.	Selling price per bushel.	Number of foreign seeds in one pound of sample.	Cost of pure germinable seed per bushel.
96,	99.0	58.5	58.5	57.9	$5 00	2,880	$8 64
208,	99.8	79.3	79.3	79.1	7 20	224	9 10

CRIMSON CLOVER.

Out of thirteen samples of Crimson Clover, not one contained sufficient impurities to drop it below the standard of purity. The seed is larger than any other clover, and being round and smooth can easily be separated from foreign seeds and inert materials. It will be observed from the table below, however, that the farmers must be very suspicious of the viability of Crimson Clover seed, especially is this true if the seed has a dark appearance. Sample No. 6 contained a large number of dark seeds and the per cent. of germination was only 72.2. Sample No. 12 was reported as seed of the crop of 1898 and was very dark throughout, having perhaps 15 per cent. of light colored seed. The per cent. of germination of this sample was only 27.5. The selling price was not reported, but assuming that $5.00 per bushel is charged, the cost of pure viable seed would be $17.52. A practically worthless case is sample No. 25, in which nearly every seed was dark, and weed seeds were not uncommon. It was reported as of the crop of 1899, which must have been a mistake. In purchasing this seed at $5.00 per bushel, the farmer

actually pays at the rate of $217.39 for a bushel of pure germinable seed. But the fact is he sows in good faith, believing the seed to be viable, and gets no "stand" of clover, which is charged to unfavorable weather or improper methods of seeding. Samples Nos. 63, 89, 173, 182 and 244 were all bright, light colored seeds, noticeably fresh, and were the only samples which tested above the standard of germination required for good seed. Nos. 94, 161 and 205 contained a large percentage of dark seeds, and the consequence is well measured by the results of the germination tests.

CRIMSON CLOVER.

Character and Cost of the Seeds on the Market. Standard of Purity, 98 Per cent. Standard of Germination, 85-90 per cent.

Number of Sample.	Per cent. pure seed	Per cent. germination in five days.	Total per cent. germination in fourteen days.	Per cent. of pure germinable seed.	Selling price per bushel.	Number of foreign seeds in one pound of sample.	Cost of pure germinable seed per bushel.
6,	99.9	70.5	72.3	72.2	$4 25	66	$5 88
12,	99.7	27.5	27.5	27.4	....	506	....
25,	98.4	2.3	2.3	2.3	5 00	2,170	217 39
63,	99.9	93.8	96.3	96.2	5 25	64	5 46
89,	98.8	87.5	87.5	86.5	3 50	1,150	4 05
94,	99.2	41	41	37.8	5 75	280	15 21
133,	99.1	76.8	78.3	77.6	5 00	1,770	6 44
161,	98.2	44	44	43.2	3 00	1,464	6 94
173,	99.7	94.3	94.5	94.2	4 75	819	5 04
182,	99.2	92.3	94.3	93.5	5 25	814	5 61
205,	99.9	62	62	61.9	4 60	0	7 43
210,	99.9	80	80.3	80.2	....	0	....
244,	99.8	94.8	96.3	96.1	....	77	....

CRIMSON CLOVER.

Number and Character of Foreign Seeds in a Pound of Each Sample.

Number of Sample.	6.	12.	25.	63.	89.	94.	133.	161.	173.	182.	205.	216.	244.
Timothy,	66	33	25	....	....	....	....	....	....	....	....	....	....
Ribgrass,	....	32	....	45	....	....	....	....	....	47	....	....	38
Sheep Sorrel,	....	98	443	....	....	....	120	304	735	425	....	....	33
Green Foxtail,	....	245	1,422	....	....	....	....	....	....	....	....	....	....
Yellow Foxtail,	....	98	....	....	....	....	....	....	....	....	....	....	....
Lamb's Quarters,	....	....	51	....	....	....	....	....	....	....	....	....	....
Bulbous Buttercup,	....	....	78	....	....	....	....	70	....	....	....	....	....
Willow-leaved Dock,	....	....	102	16	....	....	....	70	....	....	....	....	....
Tumble-weed,	....	....	51	....	270	....	....	....	....	....	....	....	....
Clover, Red,	....	....	....	....	[illegible]	245	105	185	....	240	....	....	....
Corn, Gromwell,	....	....	....	....	....	35	....	....	....	....	....	....	....
Bicknell's Crane's Bill,	....	....	....	....	....	....	1,500	....	....	....	....	....	....
Black Medic,	....	....	....	....	....	....	15	152	63	....	....	....	....
Curled Dock,	....	....	....	....	....	....	20	....	....	[illegible]	....	....	11
Black Henbane,	....	....	....	....	....	....	....	199	....	....	....	....	....
Black Mustard,	....	....	....	....	....	....	....	481	....	....	....	....	....
Cabbage,	....	....	....	....	....	....	....	....	21	[illegible]	....	....	....
Flax,	....	....	....	....	....	....	....	....	....	9	....	....	....
Total Foreign Seeds in One Pound, ..	66	506	2,170	61	1,150	280	1,779	1,464	819	814	[illegible]	0	77

So uniformly did the percentage of germination of Crimson Clover samples correspond with the proportion of bright, light-colored seeds in the samples, that Mr. W. H. Thompson, who was making the germination tests, was led to separate the dark and light seeds of eight samples and try them independently in the germinator. The results are shown in the following figures. It will be seen that even in the best samples there are some seeds darker than the rest, but they possess the brightness that belongs to fresh seed, and dark seed does not necessarily mean dead seed. However, in every case, it will be seen the dark seeds gave fewer germinations than did the light seeds.

CRIMSON CLOVER.

Comparison of Germination Power of Dark and Light Colored Seeds in Same Sample.

Number of Sample.	Per cent. germinated, sample.	Per cent. germinated, light seed.	Per cent. germinated, dark seed.
12,	27.5	80	17
63,	96.3	99	87
94,	41	45	21
133,	78.3	96	56
161,	44	38	10
173,	94.5	96	84
182,	94.3	99	76
205,	62	80	17

ALSIKE.

There were sixteen samples of Alsike examined, and of these one-half fell below the standard of purity, 95 per cent. The impurities were essentially weed seed in most cases. Timothy and Sheep Sorrel were most abundant. Docks and Tumble-weed were frequent. The Alsike seed of a few specimens were dull colored, indicating age, and in fact three samples were reported as old seed. Though the standard of germination for Alsike is placed as low as 75 per cent., one-half of the samples tested in the germinator failed to reach the required figure even though, as is customary with all clover germinations, one-third of the seeds remaining sound at the conclusion of the test was counted in as germinable seed. Samples Nos. 10 and 71 were old, dull colored seed and though sold at $8.00 and $7.50 respectively, the farmer actually paid more than $26.00 per bushel

for pure germinable seed. He obtained with his purchase a larger supply of Sheep Sorrel and Tumble-weed seed than was needed upon his farm and passes his thin catch of Alsike in the field with the observation that the season was very unfavorable for the seed to catch.

ALSIKE.

Character and Cost of the Seeds on the Market. Standard of Purity, 95 Per cent. Standard of Germination, 75-80 Per cent.

Number of Sample.	Per cent. pure seed.	Per cent. germination in five days.	Total per cent. germination in fourteen days.	Per cent. of pure germinable seed.	Selling price per bushel.	Number of foreign seeds in one pound of sample.	Cost of pure germinable seed per bushel.
10,	91.2	29.3	33.3	30.4	$8 00	9,150	$26 31
32,	99.0	49	53	52.5	7 50	2,209	14 28
37,	99.2	86.5	90.0	89.3	7.50	1,620	8 38
44,	99.1	88.8	92.8	92.0	7 00	4,732	7 61
71,	96.2	27	29.3	28.1	7 50	14,763	26 69
77,	90.3	58.8	62.8	56.7	8 00	25,872	14 11
82,	74.2	96.5	97.5	72.3	7 50	91,224	10 37
95,	97.6	64.5	69.3	67.5	6 75	9,600	10 00
101,	86.0	77.8	84	72.2	5 75	41,860	7 96
117,	87.3	87.8	91.3	79.7	6 00	40,420	7 53
130,	94.6	69.8	76	71.9	6 50	5,810	9 04
145,	84.2	58.5	61.8	54.6	3 50	48,467	6 41
172,	95.0	70.5	73.8	70.1	6 25	15,840	8 91
180,	99.5	72.8	77.3	76.9	7 50	1,316	9 75
209,	99.2	85.3	88.8	88.1	8 00	2,167	9 08
216,	91.5	70.0	70.8	64.8	9 00	28,470	13 89

ALSIKE.

Number and Character of Foreign Seeds in a Pound of Each Sample.

Number of Sample.	10.	22.	37.	44.	71.	77.	82.	95.	101.	117.	130.	145.	172.	180	209	216.
Timothy,	2,400	1,778	1,620	520	3,040	2,400	91,200	....	41,600	....	....	1,560	6,400	1,118	1,667	25,000
Sheep Sorrel,	5,416	381	....	3,900	11,400	20,400	....	9,600	....	39,200	5,480	39,000	6,400	38	....	2,500
Tumble-weed,	1,334	....	....	....	19	....	24	....	....	....	165	468	....	....	133	....
Willow-leaved Dock,	....	50	....	312	304	192	....	....	....	....	....	....	....	....	....	....
Lady's Thumb,	....	....	....	....	....	768	....	....	....	....	....	....	....	....	....	....
Green Foxtail,	....	....	....	....	....	576	....	....	....	....	....	749	....	....	....	....
Lamb's Quarters,	....	....	....	....	....	1,536	....	....	....	....	....	6,240	2,240	....	....	....
Red Clover,	....	....	....	....	....	....	....	....	[illegible]	[illegible]	....	[illegible]	....	....	....	20
Curled Dock,	....	....	....	....	....	....	....	....	....	[illegible]	110	250	800	150	100	500
Ribgrass,	....	....	....	....	....	....	....	....	....	....	55	....	....	....	....	450
Witch Grass,	....	....	....	....	....	....	....	....	....	....	....	....	....	....	267	....
Total Foreign Seeds in One Pound,	9,150	2,209	1,620	4,732	14,763	25,872	91,224	9,600	[illegible]	40,420	5,810	48,467	15,840	1,316	2,167	28,470

TIMOTHY.

Ordinarily, Timothy seed is exceedingly pure because it is easily cleaned, and the nature of the seed will not permit of adulterations, as in the case of other grasses. Among thirty-nine samples examined only three fell slightly below the required standard, and five of them were so nearly perfect, that they were rated 100 per cent. in purity. The quantity of weed seed was excessive in but a few samples and the obnoxious kinds were commonly the seeds of Lamb's Quarters and Rugel's Plantain. Nos. 81, 91 and 99 were labeled "Star Timothy." No. 100 was labeled "A No. 1," No. 88 "S. P. V. Timothy," and No. 204, "Choice." These were alike in being exceedingly clean and having high germinative power.

Old seeds failed rapidly in germination. While the age of the samples was not generally reported, it is not difficult to select from the table below the seeds which were not fresh. Sample No. 211 was the only one reported as of the crop of 1898, but before the germination tests were made, a record in our books was made of the "dull appearance of seed" in samples No. 124, 149 and 164. These four samples all failed to reach even 80 per cent. in germination. In consequence of this, sample No. 124 was the most costly Timothy seed for the farmer to buy. The standard per cent. of germination fixed by the United States Department of Agriculture, 85-90 per cent. for Timothy, can be easily maintained by the seedsman, and it is quite certain to reject old seed.

TIMOTHY.

Character and Cost of the Seeds on the Market. Standard of Purity, 98 Per cent. Standard of Germination, 85-90 per cent.

Number of Sample.	Per cent. pure seed.	Per cent. germination in five days.	Total per cent. germination in fourteen days.	Per cent. of pure germinable seed.	Selling price per bushel.	Number of foreign seeds in one pound of sample.	Cost of pure germinable seed per bushel.
2,	99.5	78	82	81.6	$2 00	589	$2 43
9,	99.2	89.5	93	92.3	1 75	10	1 89
15,	99.8	93.6	97.5	97.3	2 00	153	2 06
18,	99.0	87.8	92.8	91.9	1 75	3,683	1 90
20,	99.4	85.5	87.3	86.8	1 76	1,975	2 03
22,	99.9	88.3	89.5	89.4	2 00	470	2 24
33,	98.2	92	94	92.3	1 75	784	1 90
36,	98.8	92.3	97	95.8	1 60	1,330	1 67
41,	99.2	90.8	93.8	93.0	1 60	230	1 72
48,	98.9	87	89.8	88.8	1 75	3,019	1 97
53,	99.6	89.5	92.5	92.1	1 75	960	1 90
57,	97.4	90.0	92.8	90.4	1 75	2,610	1 94
61,	99.9	88	90.0	89.9	1 50	36	1 67
67,	99.0	90	92.8	91.9	1 50	2,310	1 63
74,	99.5	96	96.8	96.3	1 45	1,596	1 51
81,	100	92	93.8	93.8	2 10	0	2 24
87,	99.9	87.5	90.8	90.7	2 10	490	2 32
88,	99.9	90.8	92.5	92.4	1 55	392	1 68
91,	100	87.8	91.3	91.3	2 50	0	2 74
99,	100	85.3	95.5	95.5	2 25	0	2 36
100,	100	91.5	92.8	92.8	2 00	12	2 16
103,	98.4	74.3	91.5	90.0	1 40	456	1 56
104,	98.1	88.5	94.8	93.0	1 65	1,456	1 77
114,	99.9	91.3	96.3	96.2	1 65	96	1 72
124,	99.2	60.8	73	72.4	2 50	0	3 45
129,	98.0	77.8	90.5	88.7	1 40	0	1 58
137,	98.6	92.5	96.5	95.1	1 75	2,080	1 84
149,	100	69.3	78.3	78.3	1 50	30	1 92
154,	99.8	92.8	98	97.8	1 75	375	1 79
158,	99.8	83.8	92.8	92.6	1 50	135	1 62
164,	99.8	62.8	68.3	68.2	1 50	0	2 26
169,	98.9	78.8	85.5	84.6	1 50	464	1 77
183,	98.1	88.5	92.5	90.7	1 50	4,680	1 65
189,	97.6	84.5	90.5	88.3	1 65	2,465	1 87
204,	99.2	89.3	94.8	94.0	1 35	252	1 44
211,	98.1	67	78.3	76.7	90	7,182	1 17
222,	93.2	86.3	93.3	87.0	1 75	14,478	2.01
224,	99.5	88.8	94.0	93.5	1 75	1,243	1 87
240,	100	90	93	93.0	1 75	128	1 88

TIMOTHY.

Number and Character of Foreign Seeds in a Pound of Each Sample.

Number of Sample.	2.	9.	15.	18.	20.	22.	33.	36.	41.	48.	53.	57.	61.
Red Clover,	475	....	....	411	....	350	160	....	178	....	480	[illegible]	....
Lamb's Quarters,	76	10	71	195	256	40	280	....	46	311	240	725	....
Rugel's Plantain,	38	....	....	2,740	237	....	280	1,960	....	2,649	240	1,5[illegible]	36
Sheep Sorrel,	....	....	77	....	....	....	....	....	....	....	....	15	....
Lady's Thumb,	....	....	25	....	94	....	....	[illegible]	46	....	....	17	....
White Vervain,	....	....	....	337	175	....	64	80	....	....	....	249	....
Wild Peppergrass,	....	....	....	....	1,167	80	....	....	....	....	....	....	....
Green Foxtail,	....	....	....	....	46	....	....	....	....	....	....	15	....
Tumble-weed,	....	....	....	....	....	....	....	....	....	....	....	....	....
Parsnip,	....	....	....	....	....	....	....	....	....	[illegible]	....	....	....
Ribgrass,	....	....	....	....	....	....	....	....	....	....	....	....	....
White Clover,	....	....	....	....	....	....	....	....	....	....	....	....	....
Alsike,	....	....	....	....	....	....	....	....	....	....	....	....	....
Curled Dock,	....	....	....	....	....	....	....	....	....	....	....	....	....
Total Foreign Seeds in One Pound,	[illegible]	10	173	3,683	1,975	470	784	1,3[illegible]0	230	3,019	960	2,61[illegible]	36

TIMOTHY.

Number and Character of Foreign Seeds in a Pound of Each Sample—Continued.

Number of Sample.	67.	74.	81.	87.	88.	91.	99.	100.	103.	104.	114.	124.	129.
Red Clover,	1,500	665			112			12		128			
Lamb's Quarters,		855		35	196				456	1,136	96		
Rugel's Plantain,	120	76		350	84								
Sheep Sorrel,	30												
Lady's Thumb,	30												
White Vervain,				35									
Wild Peppergrass,				70									
Green Foxtail,													
Tumble-weed,	15												
Parsnip,	615												
Eel grass,													
White Clover,													
Alsike,													
Curled Dock,													
Total Foreign Seeds in One Pound, ..	2,310	1,596	0	490	392	0	0	12	456	1,456	96	0	0

TIMOTHY.

Number and Character of Foreign Seeds in a Pound of Each Sample—Continued.

Number of Sample.	137.	149.	154.	158.	164.	169.	183.	189.	204.	211.	222.	224.	240.
Red Clover,	....	....	375	81	....	64	1,800	150	126	294	....	275	....
Lamb's Quarters,	80	15	....	27	....	320	720	1,350	....	42	5,715	110	37
Rugel's Plantain,	2,800	....	....	....	....	....	1,800	450	....	420	2,540	220	15
Sheep Sorrel,	....	....	....	....	....	16	....	....	....	....	127	....	....
Lady's Thumb,	....	15	....	27	....	....	....	....	....	....	....	....	....
White Vervain,	....	....	....	....	....	16	....	60	....	....	274	99	....
Wild Peppergrass,	....	....	....	....	....	48	180	455	42	126	508	66	18
Green Foxtail,	....	....	....	....	....	....	....	....	....	....	....	11	....
Tumble-weed,	....	....	....	....	....	....	180	....	....	....	254	....	....
Parsnip,	....	....	....	....	....	....	....	....	....	....	....	....	....
Ribgrass,	....	....	....	....	....	....	....	....	84	....	....	....	....
White Clover,	....	....	....	....	....	....	....	....	....	6,300	....	440	....
Alsike,	....	....	....	....	....	....	....	....	....	....	5,080	....	55
Curled Dock,	....	....	....	....	....	....	....	....	....	....	....	22	....
Total Foreign Seed in One Pound,	2,880	30	375	135	0	464	4,680	2,465	252	7,182	14,478	1,243	128

ORCHARD GRASS.

There is great variation in the germinative power of Orchard Grass. The seventeen samples ranged anywhere between 33 and 96 per cent. and while the selling price per bushel did not vary much from $2.00 per bushel, the cost of pure germinable seed ran from $2.08 to $7.72. The chance for adulteration is great, and frequently Meadow Fescue is liberally employed, but this grass seed was present in but two samples of Orchard Grass and then in such small quantities as to be an incidental impurity. The foreign seeds most commonly present are Red Clover, Curled Dock, Wild Peppergrass, Ribgrass and Sheep Sorrel. The bulkiest impurity is chaff and broken stems and leaves.

MILLETS.

Five samples of Millets were sent in by the agents of the Department of Agriculture. These also show the greatest variation in cleanness and germination. It is an easy matter to clean millet seed with the modern cleaning machine, and there is no excuse for more than one per cent. of impurity in any sample.

ORCHARD GRASS.

Character and Cost of the Seeds on the Market. Standard of Purity, 90 Per cent. Standard of Germination (not yet fixed).

Number of Sample.	Per cent. pure seed.	Per cent. germination in five days.	Total per cent. germination in fourteen days.	Per cent. of pure germinable seed.	Selling price per bushel.	Number of foreign seeds in one pound of sample.	Cost of pure germinable seed per bushel.
3,	92.4	26.5	34.5	31.9	$2 25	8,050	$7 05
11,	94.2	37.5	61.3	57.7	2 10	4,250	3 64
23,	97.5	14.3	77	75.1	2 00	750	2 66
42,	95.8	32.5	78.8	75.5	2 00	2,088	2 65
62,	91.4	19.8	62.8	57.4	1 60	4,080	2 79
68,	97.2	35.5	79.3	77.1	1 75	2,610	2 27
107,	95.2	49.5	75.8	72.2	1 50	2,080	2 08
118,	93.8	63	75	70.4	1 50	1,486	2 13
126,	98.2	17	33	32.4	2 50	1,393	7 72
128,	93.6	59	70.3	65.8	1 50	1,171	2 28
143,	87.3	60.8	82.5	72.0	2 10	1,995	2 92
156,	90.4	95.3	96	86.8	2 40	1,272	2 76
165,	91.0	30	75.3	68.5	2 00	1,960	2 92
171,	92.4	27.5	64.8	59.9	1 75	800	2 92
185,	82.3	30.5	67.8	55.8	1 75	6,364	3 14
191,	88.3	44.5	66	58.3	2 00	450	3 43
196,	96.4	32.3	70.8	68.3	1 75	760	2 55

ORCHARD GRASS.

Number and Character of Foreign Seeds in a Pound of Each Sample.

Number of Sample.	3.	11	23.	42.	62.	68.	107.	118.	126.	128.	143.	156.	165.	171.	185.	191.	196.
Sheep Sorrel,	7,875	407	....	....	1,265	580	....	26	58	....	105	....	....	50	555	....	144
Ribgrass,	35	....	120	....	1,050	290	520	156	58	165	84	....	35	50	....	60	140
Wild Peppergrass,	140	3,050	180	464	105	174	....	....	174	....	126	....	175	....	....	30	28
Meadow Fescue,	....	305	....	....	....	....	....	....	406	....	....	....	....	....	....	....	....
Curled Dock,	....	305	120	1,508	820	870	1,170	706	117	825	1,050	72	1,225	500	925	300	168
Wheat,	....	30	....	....	....	....	....	26	....	16	....	....	....	....	74	....	....
Red Clover,	....	153	240	116	810	696	390	572	58	165	630	1,200	525	200	1,110	60	280
Pursh's Plantain,	....	....	90	....	....	....	....	....	464	....	....	....	....	....	....	....	....
Flax,	....	....	....	....	....	....	....	....	58	....	....	....	....	....	....	....	....
Timothy,	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3,700	....	....
Total Foreign Seeds in One Pound,	8,050	4,250	750	2,088	4,080	2,610	2,080	1,486	1,393	1,171	1,995	1,272	1,960	800	6,364	450	700

MILLETS.

Character and Cost of the Seeds on the Market. Standard of Purity, 99 Per cent. Standard of Germination, 85-90 Per cent.

Number of Sample.	Per cent. pure seed.	Per cent. germination in five days.	Total per cent. germination in fourteen days.	Per cent. of pure germinable seed.	Selling price per bushel.	Number of foreign seeds in one pound of sample.	Cost of pure germinable seed per bushel.
27,	100	95.5	96	96	$1 40	0	$1 46
28,	100	57.8	58	58	1 25	0	2 16
146,	99.9	91.5	91.5	91.4	3 50	68	3 83
217,	98.2	87.8	88.3	86.7	1 60	3,200	1 84
218,	93.3	77.8	77.8	72.6	1 25	16,240	1 72

MILLETS.

Number and Character of Foreign Seeds in a Pound of Each Sample.

Number of Sample.	27.	28.	146.	217.	218.
Lady's Thumb,			27	150	30
Lamb's Quarters,			41		30
Tumble-weed,				10	20
Witch Grass,				40	16,000
Finger Grass,				3,000	
White Vervain,					150
Rugel's Plantain,					10
Total Foreign Seeds in One Pound,	0	0	68	3,200	16,240

KENTUCKY BLUE GRASS.

The greatest extremes in quality of seeds were met with among the samples of Kentucky Blue Grass. There were twenty-three samples submitted to tests. Four of them were "lawn mixtures." No. 16 contained 15 per cent. of White Clover; No. 26 was composed of 15 per cent. White Clover, 20 per cent. Timothy, 15 per cent. Meadow Fescue and 50 per cent. Kentucky Blue Grass (by weight); No. 80 contained 60 per cent. of White Clover, and No. 83 had in it 25 per cent. of Orchard Grass and 9 per cent. of White Clover. The germination tests in these cases were made of the Blue Grass only. The seed of sample No. 21 was dark in color and had a musty smell. Several samples had considerable chaff, and No. 160 had, besides the few seeds accredited to it in the table of foreign seeds, a goodly supply of White Clover and Timothy. Only four of the twenty-three

samples reached the required standard in germination. All these tests of Blue Grass were made in sand in the greenhouse, the final record being taken after 30 days. By referring to the table below, it will be observed that the price of pure germinable seed is generally very high with reference to the samples examined.

KENTUCKY BLUE GRASS.

Character and Cost of the Seeds on the Market. Standard of Purity, 90 Per cent. Standard of Germination, 45-50 Per cent.

Number of Sample.	Per cent. pure seed.	Total germination in thirty days.	Per cent. pure germinable seed.	Selling price per bushel.	Number of foreign seeds in one pound of sample.	Cost of pure germinable seed per bushel.
1,	76.1	9	6.8	$2 50	16,266	$36 76
16,	Mixture.	47.5	....	25 lb.	608	....
21,	84.3	8.2	6.9	1 50	4,293	21 74
26,	Mixture.	18	....	18 qt.	233	....
35,	88.5	4	3.5	1 60	448	45 71
40,	82.4	33	2.8	2 00	2,720	71 43
60,	72.5	3	2.2	1 25	560	56 82
66,	68.4	8	5.5	1 00	1,400	18 18
80,	Mixture.	36	....	20 lb.	165	....
83,	Mixture.	48	....	20 lb.	490	....
106,	89.2	46.3	40.0	1 50	1,860	3 75
112,	74.3	8	5.9	1 35	2,380	22 88
115,	62.4	9	5.6	1 75	486	31 25
125,	68.6	7	4.8	2 50	2,212	52 08
134,	72.6	5	3.6	08 lb.	2,560	2 22 lb.
114,	79.2	22	17.5	20 lb.	16,354	1 14 lb.
155,	68.0	20	13.6	2 80	1,233	20 59
160,	62.5	6	3.8	1 40	650	36 84
167,	74.4	26	19.3	1 50	12,936	7 77
179,	72.8	32	23.3	1 75	30,065	7 51
184,	85.4	14	12.0	2 00	4,009	16 67
190,	90.3	7	6.3	1 50	1,474	23 82
219,	93.1	55	51.2	20 lb.	2,310	39 lb.

KENTUCKY BLUE GRASS.

Number and Character of Foreign Seeds in a Pound of Each Sample.

Number of Sample.	1.	*16.	21.	*26.	35.	40.	60.	66.	*80.	*83.	106.	112.
Alsike,	16,000	....	2,700	....	....	960	210	750	....	....	....	2,020
Lady's Thumb,	166	29	1,167	....	....	....	....	450	....	....	....	148
Sedge,	100	....	[illegible]	83	416	544	....	150	....	....	1,860	37
Pursh's Plantain,	....	133	....	....	....	....	....	....	....	....	....	....
Rugel's Plantain,	....	[illegible]	....	....	....	....	....	....	....	....	....	....
Ragweed,	....	57	....	....	....	....	....	....	....	....	....	....
Curled Dock,	....	[illegible]	....	....	....	32	....	....	....	....	....	101
Sheep Sorrel,	....	95	....	83	....	224	....	50	....	210	....	....
Wild Pepper-grass,	....	76	....	....	....	64	....	....	....	....	....	....
Red Clover,	....	152	27	....	32	32	....	....	55	210	....	74
Lamb's Quarters,	....	....	....	33	....	....	70	....	110	70	....	....
Flax,	....	....	....	17	....	....	....	....	....	....	....	....
Tall Meadow Fescue,	....	....	....	17	....	....	....	....	....	....	....	....
White Vervain,	....	....	....	....	....	64	....	....	....	....	....	....
Timothy,	....	....	....	....	....	800	[illegible]	....	....	....	....	....
White Clover,	....	....	....	....	....	....	....	....	....	....	....	....
Rye Grass,	....	....	....	....	....	....						
Total Foreign Seeds in One Pound of Sample,	16,266	608	4,293	233	448	2,720	[illegible]	1,400	165	490	1,860	2,380

*Lawn grass mixture.

KENTUCKY BLUE GRASS.

Number and Character of Foreign Seeds in a Pound of Each Sample—Continued.

Number of Sample.	115.	125.	134.	144.	155.	160.	167.	170.	184.	190.	219.
Alsike,	....	....	800	16,120	833	....	9,600	4,200	3,800	1,1[illegible]	....
Lady's Thumb,	....	....	....	....	....	....	....	70	95	1[illegible]2	....
Sedge,	270	560	300	140	333	....	....	245	....	174	42
Pursh's Plantain,	54	....	....	....	....	....	....	....	....	....	....
Rugel's Plantain,	....	....	....	....	....	650	....	....	....	....	....
Ribgrass,	....	....	....	....	....	....	....	....	....	....	....
Curled Dock,	....	....	20	47	....	....	48	70	10	[illegible]	42
Sheep Sorrel,	....	467	140	....	67	....	....	1,77[illegible]	....	22	11
Wild Peppergrass,	54	....	....	47	....	....	....	....	....	44	84
Red Clover,	27	....	....	....	....	....	288	21,000	95	....	....
Lamb's Quarters,	....	....	300	....	....	....	21	70	....	....	....
Flax,	....	....	....	....	....	....	....	....	....	....	....
Tall Meadow Fescue,	....	....	....	....	....	....	....	....	....	....	....
White Vervain,	....	....	....	....	....	....	....	....	....	....	21
Timothy,	....	....	1,000	....	....	....	2,4[illegible]	2,625	....	....	....
White Clover,	81	1,185	....	....	....	....	....	....	....	....	2,1[illegible]
Rye Grass,	....	....	....	....	....	....	576	35	....	....	....
Total Foreign Seeds in One Pound of Sample,	486	2,212	2,560	16,354	1,233	650	12,9[illegible]	30,085	4,000	1,471	2,[illegible]10

VEGETABLE SEEDS.

Frauds in vegetable seeds cannot be easily detected. They are usually of a different character from that of the frauds perpetrated in agricultural seeds. Purity of variety or strain among vegetable seeds is what gives them their special value and it is utterly impossible to detect any imposition in this regard by a study of the seeds. Most vegetable seeds are supplied to the purchaser 100 per cent. pure, so far as foreign seeds and materials are concerned, and the per cent. of germination will commonly run over 90 per cent. in fresh seeds. Samples of onions, sweet corn and cauliflower were chosen because large quantities of the two first named are used by farmers and gardeners, and sometimes considerable complaint is made about the results obtained from them. Cauliflower seed, particularly of the Dwarf Erfurt variety, is imported and is expensive; hence the temptation to adulterate is strong. Frequently cauliflower seed is bought at $1.00 or more per ounce and the outcome of it is either few plants of cauliflower or many plants of cabbage. Low germination power can be detected by tests, but the substitution of cabbage for cauliflower seed cannot be easily determined.

Onions. Twenty-one samples of Onion seed were examined and all but three of them were 100 per cent. pure seed. Only the Yellow Globe Danvers was called for, and in the table below only this variety is represented. The impurities in No. 108 consisted of timothy seed which possibly entered the sample by accident. The impurities in No. 113 were seeds of timothy and clover. In No. 135 were many seeds of cabbage and a few of Lamb's Quarters. In the germination tests, seventeen of the twenty-one samples fell short of the standard of germination placed for onion seed. Two samples were below 25 per cent.

Cauliflower. Only a few samples of Cauliflower were received, and these were not all of the early Erfurt variety. No. 132 was labeled Paris Golden, and Nos. 187 and 198 were Early Snowball. The seed in every case was absolutely free from dirt and foreign seeds. Germination ran rather low in one-half of the samples and one was absolutely worthless, having the appearance of being old seed.

ONIONS—YELLOW GLOBE DANVERS.

Character and Cost of the Seeds on the Market. Standard of Purity, 99 Per cent. Standard of Germination, 80-85 Per cent.

Number of Sample.	Per cent. pure seed.	Per cent. germinated in five days.	Total per cent. germination in fourteen days.	Per cent. of pure germinable seed.	Selling price per pound.	Cost of pure germinable seed per pound.
7,	100	60.5	66	66.0	$2 00	$3 03
13,	100	70.3	77.5	77.5	1 50	1 93
36,	100	55.3	56.5	56.5	1 50	2 65
47,	100	80.8	91.3	91.3	1 50	1 64
52,	100	82.5	83.5	83.5	1 50	1 79
73,	100	80.5	84.8	84.8	1 25	1 47
79,	100	89	90.5	90.5	1 50	1 66
98,	100	56	62.5	62.5	1 40	2 24
108,	99.8	57.3	60.3	60.2	1 50	2 49
110,	100	76.5	77.3	77.3	1 50	1 94
113,	99.8	20.5	21.8	21.8	1 60	7 34
122,	100	46.5	50.8	50.8	90	1 79
135,	98.1	72.5	79.3	77.8	1 00	1 29
139,	100	87	87.3	87.3	....	....
153,	100	69.8	70.3	70.3	1 25	1 78
176,	100	63.3	66	66.0	....	....
188,	100	74.5	75.3	75.3	....	....
194,	100	21.8	24.5	24.5	....	....
197,	100	80.3	83	83.0	1 25	1 51
213,	100	63	64.8	64.8	05 oz.	077 oz.
214,	100	60.3	65.8	65.8	05 oz.	076 oz.
215,	100	40.3	44.8	44.8	05 oz.	111 oz.
221,	100	48	57.3	57.3	05 oz.	087 oz.

CAULIFLOWER.

Character and Cost of the Seeds on the Market. Standard of Purity, 99 Per Cent. Standard of Germination, 80-85 Per Cent.

Number of Sample.	Per cent. pure seed.	Per cent. germinated in five days.	Total per cent. germination in fourteen days.	Per cent. of pure germinable seed.	Selling price per pound.	Cost of pure germinable seed per pound.
65,	100	89.3	89.5	89.5	$1 00 oz.	$1 12 oz.
121,	100	60.8	65.5	65.5	1 00 oz.	1 53 oz.
132,	100	54.8	55	55.0	80 oz.	1 45 oz.
141,	100	79.8	82.5	82.5	1 35 oz.	1 64 oz.
147,	100	73	74.5	74.5	....	....
177,	100	0	0	0.0	....	....
187,	100	66	68	68.0	1 00 oz.	1 47 oz.
198,	100	89	90.3	90.3	....	....

Sweet Corn. There is very little opportunity for fraud in Sweet Corn seed. The impurities are reduced to nothing, and many of the varieties can be readily identified by the grains. It is possible, however, to sell seeds of low germinative power and thus impose upon the purchaser. Out of twenty-five samples of the Stowell's Evergreen Corn, only three samples fell below the standard per cent. in germination, one sample being so low as 53.5 per cent. The prices varied greatly without apparent cause. It is certain the prices in no manner corresponded with the germinative power of the seeds.

SWEET CORN—STOWELL'S EVERGREEN.

Character and Cost of the Seeds on the Market. Standard of Purity, 99 Per cent. Standard of Germination, 85-90 Per cent.

Number of Sample.	Per cent. pure seed.	Per cent. germinated in five days.	Total per cent. germinated in fourteen days.	Per cent. of pure germinable seed.	Selling price.	Cost of pure germinable seed.
8,	100	86	88	88	$2 50 bu.	$2 84 bu.
14,	100	96	96	96	2 50 bu.	2 60 bu.
29,	100	88.5	88.5	88.5	10 pt.	11 oz.
46,	100	91	91	91	10 qt.	11 qt.
51,	100	98	98	98	2 25 bu.	2 30 bu.
56,	100	97.5	97.5	97.5	2 00 bu.	2 05 bu.
64,	100	98.5	98.5	98.5	1 75 bu.	1 78 bu.
72,	100	86	86	86	2 50 bu.	2 91 bu.
78,	100	90	90	90	10 qt.	11 qt.
97,	100	93	93	93	2 25 bu.	2 42 bu.
109,	100	89	91.5	91.5	10 pt.	11 pt.
111,	100	97.5	97.5	97.5	10 pt.	10 pt.
123,	100	92	92	92	1 75 bu.	1 90 bu.
127,	100	93.5	94	94	10 qt.	11 qt.
136,	100	79	81	81	10 qt.	12 qt.
140,	100	51	53.5	53.5	2 50 bu.	4 67 bu.
148,	100	95.5	95.5	95.5	15 qt.	16 qt.
157,	100	99.5	99.5	99.5	10 qt.	10 qt.
178,	100	87.5	89	89	4 25 bu.	4 78 bu.
195,	100	94.5	94.5	94.5	4 50 bu.	4 76 bu.
199,	100	91.5	92	92	20 qt.	22 qt.
200,	100	97	97	97	....	....
201,	100	98.5	98.5	98.5	....	....
202,	100	98	98	98	....	....
203,	100	79.5	79.5	79.5	....	....

THE WEEDS REPRESENTED IN THE FOREIGN SEEDS.

In the list below, only those weeds are noted which were more or less common in the samples of seeds examined. Occasional seeds of many other kinds of weeds were found, but never in sufficient quantity to merit notice here. Every sample was carefully examined and the foreign seeds removed for identification which was greatly facilitated by the use of the five hundred samples of "Economic Seeds" distributed by the Division of Botany of the United States Department of Agriculture, supplemented by a collection of 2,000 samples possessed by the Pennsylvania State College.

On the whole, the samples of farm seeds were fairly well cleaned, and in the matter of purity, they were generally as high as or higher than the standard fixed by the United States Department of Agriculture. None of the weed seeds found could be classed with the Canada Thistle as regards their obnoxious characters. A very few of them are weeds not yet known to be in Pennsylvania.

Alsike (Trifolium hybridum L.) *Alsatian Clover. Swedish Clover.* Cultivated for fodder. Occurs as a weed in waste places from Nova Scotia to Idaho, south to New Jersey and Georgia. The seeds, which resemble that of White Clover, though much darker, occurred as an impurity, particularly in the Kentucky Blue Grass seed. For lawn purposes the presence of Alsike in the Blue Grass seed is objectionable; but for pasture fields it offers no disadvantage.

Barnyard Grass (Panicum Crus-galli L.) *Cockspur Grass.* A widely distributed weed, found all over the United States, and was introduced from Europe. It prefers rich land and is commonly found in great luxuriance in and about barnyards; hence the name. The seeds are large and can easily be separated from crops of agricultural seeds; therefore, it is seldom present in properly cleaned seeds. It was found in very small quantities only, and that in two samples of Red Clover.

Bicknell's Crane's-bill (Geranium Bicknelli Britton). A native plant at present found from Maine to Southern New York. It is an annual, growing 10 to 20 inches high. The seeds were present in only one sample of seed and that the Crimson Clover (sample No. 133), grown probably within the territory indicated above. While the plant as a weed may be easily controlled, no farmer wants to pay for seed that will be of no benefit to him. The seed of this Crane's-bill is much smaller than the Crimson Clover and could be easily separated.

Black Medic (Medicago lupulina L.) *Blackseed Hop Clover, Melilot Trefoil.* An annual clover-like plant introduced from Europe and widely distributed as a weed. The seeds occurred as an impurity

in Crimson Clover only, and there in very small quantities. Not more than three samples contained it (Nos. 133, 161 and 173). Here again the seed is enough smaller than the seed of Crimson Clover that it could be easily and entirely separated in the cleaning process.

Black Mustard (Brassica nigra (L) Koch). A weed commonly known to farmers. It grows from 2 to 5 feet high and may be readily recognized by its turnip-like characters. The seeds closely resemble those of the turnip, and were present only in one sample of seeds under examination (No. 161), being a Crimson Clover reported as coming from Ohio.

Black Henbane (Hyoscyamus niger L). A member of the Nightshade family, naturalized from Europe, found in the Northern States from Nova Scotia to Michigan, south to New York. It grows from one to two feet high and has a very disagreeable odor about its leaves. The seeds were found, as in the preceding case, only in sample No. 161 Crimson Clover, from Ohio.

Bulbous Buttercup (Ranunculus bulbosus L). There are several Buttercups whose seeds are likely to occur in agricultural seeds. They are not very obnoxious weeds, but are widely distributed, being found mostly in wet places. A few seeds per pound were found in two samples of Crimson Clover from the West (Nos. 25 and 161). These two samples, though above the standard in purity, possessed the greatest amount of impurities of all in the Crimson Clover.

Cabbage (Brassica oleracea var.) Just how Cabbage could become an impurity in Crimson Clover seed is not easily accounted for. Possibly as an accident in the careless handling of the seeds in the store, rather than in the process of harvesting and cleaning. The Cabbage seed was found in two samples (No. 173 and 182), from the different stores in Pittsburg. It was also present in large quantity in a sample of Onion from Reading.

Clover, Red (Trifolium pratense L.) The seeds of Red Clover are a very common impurity in agricultural seeds and while it cannot be regarded as a weed in ordinary farm crops, it is often objectionable when it occurs in Blue Grass seed used upon lawns. It was present in about 50 per cent. of samples of Kentucky Blue Grass examined, 38 per cent. of Crimson Clover, 44 per cent. of Alsike, 94 per cent. of Orchard Grass and 50 per cent. of Timothy. Red Clover seed is more expensive than any of these just referred to, excepting the Alsike, and hence, where it is not objectionable in the crop it may be tolerated in the seed.

Clover, White (Trifolium repens L.) White Clover seed occurred as an impurity in only two samples of Timothy and three of Kentucky Blue Grass. Where the latter were marked "Mixtures" for lawns, the samples contained from 10 per cent. to 60 per cent. of White

Clover. This was not recorded therefore as "impurity" in the tables of "foreign seeds."

Corn Gromwell (Lithospermum arvense L.) *Salfern Stoneseed.* An annual or biennial plant naturalized from Europe. It is a weed of our fields east of the Mississippi river, grows 6 to 20 inches high, and has small white flowers. The seeds are brown, wrinkled and pitted, with two flat sides showing that four seeds are clustered about the pistil of the flower. The seeds in very small quantity were found in but one sample (No. 94), of Crimson Clover. The Gromwell seed is much larger than that of Crimson Clover, and hence can be easily removed.

Curled Dock (Rumex crispus L.) This troublesome weed was introduced from Europe and now occurs throughout the United States. The seeds occur very commonly as an impurity in farm seeds. The seed of Curled Dock may be recognized as a triangular seed about the size of Red Clover seed, and of a beautiful, glossy, nutbrown color. It was generally present in the Orchard Grass, Kentucky Blue Grass, Alsike and Red Clover.

Finger Grass (Syntherisma sanguinalis (L.) Nash.) *Large Crab Grass* This common weedy grass, brought to us from Europe, is found in all cultivated regions. The seed was present in only three samples of Red Clover and one of Millet. It was in inexcusable abundance in the Millet.

Flax (Linum usitatissimum L.) *Linseed.* Flax often escapes from cultivation and lingers about as a weed. The flat shining seeds are well known to farmers and when present among grasses or clovers may be easily distinguished. They were only very rarely present in the samples examined.

Green Foxtail Grass (Ixophorus viridis (L.) Nash.) This annual grass and its companion the Yellow Foxtail Grass are well known to every person who has entered a corn field in the fall. They came to this country from Europe many years ago and found that our climate in all parts of the United States was favorable to their growth. The seed is often present in farm seeds and every farmer should have in a small vial a sample of the cured seed of this and indeed of all the obnoxious weeds of his farm, and thus be aided in determining the impurities of the seeds he uses. Green Foxtail Grass seed was most frequently present in the samples of Red Clovers, but occasionally also in Crimson Clover and Timothy.

Heal-all (Prunella vulgaris L.) *Self-Heal.* This pernicious little weed is a member of the Mint family of plants, has a square stem, opposite leaves, and a terminal spike of purple flowers. In the lawn it persists in holding on, spreading and killing out the Blue Grass. In the fields it is no blessing, though less of a curse than upon the

lawn. The seeds are about the size of Red Clover seed, with the shape of a Castor Oil bean, and a nut brown color. They were present only in a few samples of Red Clover; in one case, over 6,000 seeds to the pound of sample.

Lady's Thumb. (Polygonum Persicaria L.) This is another European weed that has become common over the United States. It is an annual that may be kept in subjection by cultivation where the cultivator and hoe can be used. The seeds are about the size of Crimson Clover seed, somewhat flattened, with a shining, ebony black color. This impurity occurs very generally in the Clovers and occasionally in Timothy and Blue Grass.

Lamb's Quarters (Chenopodium album L.) *White Goose-foot. Pigweed.* This common weed of our fields and gardens is very well known, still but few persons are likely to recognize its seed when it occurs as an impurity. A specimen of the ripened seed is easily obtained and cleaned for reference and should be preserved for that purpose by farmers and merchants who handle farm seeds. Seeds of this weed were most commonly present in Timothy, though frequently found also in Blue Grass and the Clovers.

Meadow Fescue Grass (Festuca elatior L.) This grass is cultivated for fodder, but is widely distributed as a weed of the field east of the Mississippi river. It is likely to be present in grass seeds which resemble the seed of this Fescue, as in the case of Orchard Grass. It was occasionally found in Blue Grass and Red Clover.

Parsnip (Pastinaca sativa L.) This plant is a weed that is frequently seen in neglected fence rows, escaped from cultivation. The large flat seeds easily recognized were strangely present in a sample of Timothy, from which it could have easily been removed.

Pursh's Plantain (Plantago Purshii R. & S.) This is a weed of plains and prairies west of the Mississippi river that no doubt will soon be, if not already, found in the east. The seed is boat-shaped and closely resembles the seed of the Ribgrass or Buckhorn (P. lanceolata) of our eastern fields. It is, however, larger and of a lighter brown color, being almost white on the concave side. This seed was present in a few samples each of the Orchard Grass, Blue Grass and Red Clovers.

Ragweed (Ambrosia artemisiaefolia L.) No weed is more common in our neglected fields than this Ragweed. We cannot refer it to Europe except as it has been introduced there from our country. Farmers are well acquainted with its character and the appearance of the seed. It is seldom present in properly cleaned seed; in fact, it was found in but one out of 250 samples of seeds.

Rib-grass (Plantago lanceolata L.) *Buckhorn, English Plantain.* This troublesome weed is another representative of Europe with a

reputation. It is probably all over the United States. The seed is shining brown, boat shaped, about the size of Crimson Clover seed. It was the most frequently present of all the weed seeds in the clover and occasionally in the grasses. In some samples it occurred in large quantities, as is shown in the appropriate tables.

Rugel's Plantain (Plantago Rugelii Dec.) This plantain resembles our common Plantain (P. major L.) The seed is black with a light colored spot on the flat side. It might easily be mistaken for mouse dirt in Clover seed unless one should use a magnifying glass. This was most frequently an impurity of the Timothy seed and often as many as 2,000 to 3,000 seeds to the pound of sample.

Rye Grass (Lolium perenne L.) This grass weed of cultivated grounds is widely spread in this country but is a native of the Old World. Its seeds are seldom present in the ordinary farm seeds. Among all the samples submitted for examination it was contained in but two of them, these being of Blue Grass, and then only in small quantities.

Sedge (Carex sp.) Several Sedges are weeds in wet lands, and may often be found occupying wet spots in meadows, from which they do not go very far astray. The seeds are usually triangular or flat. A species of Carex having a flat brown seed was present in nearly all the samples of Blue Grass, but in no case among other kinds of seeds.

Sheep Sorrel (Rumex acetosella L.) A common and persistent weed known everywhere. Though quite small it grows and thrives along with any crop that may be planted. It loves particularly sour and sterile land. The seed when it occurs as an impurity of farm seeds may have two appearances, one the shining brown, triangular form common to Rumex, and the other with a dull brown reticulated surface due to the covering which the seed usually retains. This seed is very generally present in farm seed. It is so much like Alsike in general appearance that it is difficult to separate the two thoroughly, consequently we find it as a serious adulterant of Alsike.

Spotted Spurge. (Euphorbia nutans Lag.) This Spurge is seen commonly in thickets and cornfields but may be found in some places among the clover. It is an annual that gives but little annoyance as a weed. The very small globular seeds are seldom present in well cleaned seeds. They were found only in three samples of Red Clover.

Timothy (Phleum pratense L.) Timothy seed occurred as an impurity in all kinds of farm seeds examined in greater or less quantities. It was most abundant and at the same time most serious in

the Kentucky Blue Grass and Alsike. In one sample of the latter over 90,000 were estimated to a pound of sample.

Tumble-weed (Amaranthus graecizans L.) This weed is common over the United States. Its popular name is well deserved, for the tumbling about of this weed with the winds of fall and winter is observed everywhere. The seeds are small, shining black bodies about the size of White Clover seed, and are very likely to occur as impurities in any of the clovers.

White Vervain (Verbena urticifolia L.) *Nettle-leaved Vervain.* A common weed in waste places. It is best removed from farm seeds by cutting out the plants before the crop is harvested. The seeds are as long as Crimson Clover seed, but very slender, and light brown in color. It is most likely to occur in Timothy and Millets.

Wild Peppergrass (Lepidium Virginicum L.) This native weed occurs in our fields and meadows, and, like in the preceding case, its seeds could be most cheaply excluded from farm seeds by cutting out the weeds from the fields before the crop is harvested. The seeds were present in small quantities only in the grass examined —Timothy, Orchard Grass and Kentucky Blue Grass.

Willow-leaved Dock (Rumex salicifolius Weinm). *White Dock.* This native Dock is generally in swampy land. It grows from one to three feet high and is quite distinct from other Docks in having very narrow leaves. The seeds are brown and triangular when separated from the broad-winged covers of the flowers. They were present in samples of clovers, particularly, the Mammoth Red Clover.

Witch Grass (Panicum capillare L.) *Tumble-weed.* Dried plants of this grass roll about in the wind after the fashion of the Amaranth Tumble-weed and is often found with the latter and is also known as a Tumble-weed. The seeds are produced in abundance, but were found in comparatively few samples of farm seeds, mostly Red Clovers.

Yellow Foxtail Grass (Ixophorus glauca (L.) Nash.) *Pigeon Grass.* This grass weed is recognized as the companion of the Green Foxtail, found in cultivated fields. It is the larger and coarser of the two in every way, even the seeds are decidedly larger. For this reason, no doubt, they occurred less frequently as impurities in the Clover seeds.

CONCLUSIONS.

Viewing the question of the seed supply in Pennsylvania from the facts learned by this investigation, we may conclude that there are farm seeds placed on sale that are exceedingly poor and even

worthless. Since the samples were drawn from about 55 stores and these were located principally in the cities and larger towns, it is reasonable to believe that the worst conditions of this problem have not been touched, for a dealer with an extensive trade is always more discriminating in making the purchases for his own supply than one having but an occasional call for a particular line of goods. Nevertheless, unscrupulous dealers may be located in large as well as small towns, and the farmer, when making the purchase of his seeds, should insist upon knowing more about the quality of the seeds offered than can be learned from its appearance and price. The dull appearance common to old seed is not readily observed, unless samples of fresh seeds of the same kinds are near at hand for comparison, and the prices of seeds, as shown by the preceding tables, are no index of their true agricultural value. A sample of Red Clover at $6.50 per bushel has an agricultural value of 74.9 per cent.; another at $4.75 per bushel has an agricultural value of 90.8 per cent.; and again one at $6.00 per bushel has an agricultural value of 96.5 per cent., while another at $5.00 per bushel has an agricultural value of 22.6 per cent., and thus it is for all kinds of seeds.

No farmer can judge of the true value of a given sample of seed by its appearance and price any more than he can judge the quality of a fertilizer from similar data. The true index of the latter to the farmer is in the chemical analysis placed upon the bag containing the fertilizer, and so the true index of the agricultural value of a sample of seed can only be in a statement of the per cent. of pure germinable seed contained in it. With such a statement he can judge if the price attached is cheap or dear and he can determine whether he should plant the seeds thickly or thinly upon his farm. The large seed houses determine such facts for themselves to protect their own reputations for supplying only reliable seeds, and if farmers would always insist upon having such a statement when buying a quantity of seed, it would soon become the custom to have with every shipment of seeds in bulk the per cent. of pure germinable seed. The farmer will then be able to choose intelligently between two samples of Red Clover, for example, like sample No. 50 and No. 102. The former has 74.1 per cent. pure germinable seed, at $6.25 per bushel; the latter has 94.3 per cent. pure germinable seed, at $6.60 per bushel. The calculation shows that for good seed the latter article is cheaper per bushel by $1.43; and the further analysis of the samples shows 2,500 weed seeds (principally Ribgrass or Narrow-leaved Plantain), to the pound in No. 50, and only 15 (Green Foxtail), in No. 102. It is very clear, therefore, that the higher priced article is the cheaper seed to buy.

It has long been known that poor seeds have been sold to farmers, and many attempts have been made to prevent such frauds. If a law

can be enacted by the Legislature of Pennsylvania, one that is not too cumbersome to the seed dealers who aim to do an honest business regularly, and that will prevent the sale of inferior seeds, our farmers would experience a large measure of relief from the present impositions.

Such a law should require every seed producer or dealer to affix to every package or bulk of grasses, clovers and other forage plants, commonly known as agricultural seeds, sold in quantities of one pound and upwards, a guarantee stating the percentage of purity and of vitality. Such guarantee should, as a matter of protection to both producer and consumer, be required to be dated, and a reasonable limit of time should be fixed by the law at which the liability of the guarantor should terminate. All guarantees should be made to expire with the planting of the seed or 60 days after their purchase by the consumer. Seeds of vegetables, flowers, shrubs and trees might well be exempt from the action of this law, because fraud in the sale of them is seldom perpetrated, and when it is, the nature of it is such that it cannot be detected in the seed. All such seeds, however, as well as those sold in quantities of less than one pound should be required to be marked with the year of their growth. The purchaser of seeds is entitled to know these facts about the seeds he buys, and the honest seedsman should not refuse to give them. Proper penalties should of course be provided for failure to comply with the law or for false guarantees. In Pennsylvania, the enforcement of the law would naturally be placed in the hands of the Secretary of Agriculture, who should be authorized to secure and examine samples and publish the results substantially as in the case of commercial fertilizers and to proceed against violators of the law.

The effect of such a law will be, if properly enforced, to drive out of the market inferior seeds, therefore greater care will be exercised in the cleaning of seeds and the farmers must expect to pay a higher price for his seeds. However, the statistics given in this Bulletin show that often the higher-priced seeds are the cheaper to the farmers.

APPENDIX.

The laws enacted or under consideration in other States are appended to indicate the efforts being put forth to regulate the sale of agricultural seeds.

The law printed below was enacted in 1897 by the Maine Legislature.

AN ACT TO REGULATE THE SALE OF AGRICULTURAL SEEDS.

Section 1. Every lot of seeds of agricultural plants, whether in bulk or in package, containing one pound or more, and including the seeds of cereals (except sweet corn), grasses, forage plants, vegetables, and garden plants, but not including those of trees, shrubs and ornamental plants, which is sold, offered or exposed for sale for seed by any person or persons in Maine, shall be accompanied by a written or printed guarantee of its percentage of purity, freedom from foreign matter: Provided, That mixtures may be sold as such when the percentages of the various constituents are stated.

Section 2. Dealers may base their guarantees upon tests conducted by themselves, their agents, or by the Director of the Maine Agricultural Experiment Station: Provided, That such tests shall be made under such conditions as the said Director may prescribe.

Section 3. The results of all tests of seeds made by said Director shall be published by him in the bulletins or reports of the Experiment Station, together with the names of the person or persons from whom the samples of seeds were obtained. The said director shall also publish equitable standards of purity together with such other information concerning agricultural seeds as may be of public benefit.

Section 4. Any person or persons who shall sell, offer or expose for sale or for distribution in this State agricultural seeds without complying with the requirements of sections one and two of this act, shall, on conviction in a court of competent jurisdiction, be fined not to exceed one hundred dollars for the first offense, and not to exceed two hundred dollars for each subsequent offense.

Section 5. Any person or persons who shall, with intention to deceive, wrongly mark or label any package or bag containing garden or vegetable seeds or any other agricultural seeds, not including those of trees, shrubs, and ornamental plants, shall be guilty of a misdemeanor and upon conviction in a court of competent jurisdiction shall be fined not to exceed one hundred dollars for the first offense and not to exceed two hundred dollars for each subsequent offense.

Section 6. The provisions of this act shall not apply to any person or persons growing or selling cereals and other seeds for food.

Section 7. Whenever the Director of the Maine Agricultural Experiment Station becomes cognizant of the violation of any of the provisions of this act, he shall report such violation to the Secreof the Board of Agriculture, and said Secretary shall prosecute the party or parties thus reported.

Section 8. All acts and parts of acts inconsistent with this act are hereby repealed.

Section 9. This act shall take effect September one, eighteen hundred ninety-seven.

A BILL ENTITLED AN ACT TO REGULATE THE SALE OF AGRICULTURAL SEEDS IN THE STATE OF MARYLAND, PROVIDE FOR THEIR INSPECTION, AND TO APPROPRIATE A SUM OF MONEY THEREFOR.

Section 1. Be it enacted by the General Assembly of Maryland that every lot of the seeds of agricultural plants of one pound or more, whether in bulk or in package, and including the seeds of cereals, grasses, clovers and other forage plants, but not including the seeds of vegetables, flowers, trees, and ornamental shrubs, which are sold or offered for sale in the State of Maryland, for seed purposes, shall be accompanied by a written or printed statement of the percentage of purity (freedom from foreign matter), the percentage of germinable seed, and a statement as to the presence or absence of the seeds of dodder (Cuscuta), Canada thistle, (Carduus arvensis), and the bulblets of wild onions (Allium vineale).

Section 2. Be it enacted that all packages of seeds of any kind, sold for seed purposes, and in packages of less than one pound and all vegetable seeds in packages of one pound or more, shall be plainly marked with the year in which they were placed on the market.

Section 3. And be it enacted that the Maryland Agricultural College is hereby authorized and directed to receive from any resident of the State of Maryland, not a dealer in seeds, samples of seeds as above specified, purchased by him for actual use, together with the dealer's statement accompanying the same, and to make tests of such samples; and the Maryland Agricultural College, or its duly authorized agent, is hereby authorized to prescribe the rules and regulations under which these samples shall be received and tested.

Section 4. And be it enacted that if the official test of any sample falls more than two per cent. in purity, or ten per cent. in germination below that indicated in the dealer's statement, the dealer shall either take back the seed and refund the purchase price, paying all charges, or shall refund a pro rata amount of the purchase price, as the buyer may elect, but no claim against the dealer shall be valid if presented after the seed is planted, or more than two months after the sale of the seed.

Section 5. And be it enacted that the Maryland Agricultural College or its representatives, is hereby authorized to secure for test, by purchase at the market price, if necessary, samples of any lot or lots of seed, as described in section one, sold or offered for sale in the State of Maryland, together with the dealers' written or printed statements concerning the quality of such seeds, and to pub-

lish annually all tests made at the College, together with the names of the dealers and their statements of quality.

Section 6. And be it enacted that any seedsman or dealer, offering seeds for sale in the State of Maryland after July first nineteen hundred, not in compliance with sections one and two of this act, or failing to comply with the requirements of section four of this act, shall be deemed guilty of a misdemeanor, and shall be subject to a fine not to exceed one hundred dollars for the first offense and two hundred dollars for every subsequent offense, on trial and conviction before a justice of the peace, or by indictment in court.

Section 7. Be it enacted that the Treasurer of the State, upon the warrant of the comptroller, be and he is hereby authorized and directed to pay to the Board of Trustees of the Maryland Agricultural College, or their duly bonded officer, one thousand dollars annually, on July the first of each year, to carry out the provisions of this act.

Section 8. And be it enacted that it shall be the duty of all States Attorneys to prosecute all persons accused of violating this act, or any of the provisions of this act.

Section 9. And be it enacted that all acts or parts of acts inconsistent with the provisions of this act, are hereby repealed.

Section 10. And be it enacted that this act shall take effect on July the first nineteen hundred.

This law failed to pass in the Legislature of Maryland because of opposition from seed dealers' associations. A similar law in Minnesota likewise failed in the Legislature of 1900.

DRAFT OF LAW UNDER CONSIDERATION IN NORTH CAROLINA.

An act to govern the sale of field and garden seeds in North Carolina and to prevent fraud in the sale of such seeds.

The General Assembly of North Carolina do enact:

Section 1. That the State Board of Agriculture shall at the regular meeting next after the ratification of this act, adopt and publish rules and regulations for governing the sale of field and garden seeds in this State. Such rules and regulations shall not conflict with the Constitution of this State, or of the United States. They may be modified, extended or otherwise changed at any subsequent regular meeting of the Board.

Section 2. That the Board of Agriculture shall publish such rules and regulations in the official Bulletin and such State newspapers as they elect. The Board shall give thirty days' notice before such rules become operative. Such rules, when officially published shall have the effect and authority of law.

Section 3. That the Board shall provide a duly qualified expert

and all necessary apparatus for testing seeds and shall set apart room for such work in the Department building. The Board shall prescribe the method for determining the purity, viability and cultural worth of seeds; said method shall be that recommended by the Association of American Agricultural Experiment Stations and Colleges, with such modifications as the Board shall from time to time adopt.

Section 4. That the Board of Agriculture shall publish a minimum of quality or cultural worth for each variety of field and garden seeds commonly sold in this State. No sample of seeds falling below the specified minimum shall be permitted to be sold for planting in the State. The Board shall cause samples of field and garden seeds to be collected in the markets of the State from time to time. Any seeds offered for sale and falling below the prescribed minimum, or which are untrue to name, shall be seized and destroyed without recompense to the owner. The person, firm or corporation offering such infra-minimum seeds shall be guilty of a misdemeanor as prescribed in section 9 of this act. But nothing in this act shall be construed to prevent the sale of any grade of seeds as grain or for any purpose other than planting or propagation.

Section 5. That no person, firm or corporation shall sell field or garden seeds for planting in this State without a license from this Board of Agriculture. The Board of Agriculture shall issue a license to deal in field and garden seeds to any applicant of good character having a permanent and localized domicile in this State, upon application, complying with the rules and regulations of the board governing the sale of seeds. No charge shall be made for such license. The period for continuance of license shall be determined by the board.

Section 6. Every person, firm or corporation licensed to deal in field and garden in this State shall be entitled to have 25 samples of seeds analyzed and certified by the expert of the Board of Agriculture free of charge. Additional samples shall be charged for at cost of doing the work.

Section 7. Every *bona fide* purchaser of seeds for planting, a resident of this State, shall be entitled to have as many samples of seeds examined and certified by the expert of the Board of Agriculture as he desires, free of charge, provided, such are intended for planting by the person sending the samples or by his tenants, and the samples are taken and described as required by the rules of the Board of Agriculture.

Section 8. That the board shall prescribe the form of guarantee of labels and certificates to be attached to packages of seeds exposed for sale in this State and may supply licensed dealers with official labels at net cost of the same.

Section 9. Every unlicensed person, firm or corporation offering for sale field or garden seeds for planting in this State; every person, firm or corporation offering seeds fraudulently labeled or misbranded or below the minimum prescribed by the board for such seeds; and every person, firm or corporation violating any of the rules and regulations of the Board of Agriculture for governing the sale of seeds, shall be guilty of a misdemeanor and upon conviction shall be fined not less than $5.00 nor more than $50.00 for each offense. Such persons, firms or corporations shall also upon conviction forfeit the license they may have from the board and the board may refuse to reissue such license. But nothing in this act shall be construed to prevent any person without license from dealing in seeds as grain for other use than planting, or from selling seeds of his own growth to dealers. All fines recovered under this act shall be paid into the treasury department of the State Department of Agriculture.

Section 10. That it shall be the duty of every solicitor to whom the Commissioner of Agriculture shall report any violation of this act, to cause the persons, firms or corporations violating to be prosecuted as provided in this act.

Rules and Regulations for Governing the Sale of Field and Garden Seeds for Planting in North Carolina.

1. No person, firm or corporation shall advertise or offer for sale, barter or gift in this State any variety of field or garden seed for planting unless a license to deal in such seeds has been procured from the State Commissioner of Agriculture. But any person may without license sell or otherwise dispose of field or garden seeds grown by himself or upon his own land to any dealer in seeds.

2. Seeds intended for used other than planting may be sold by any one without license or certification.

3. A license to deal in field and garden seeds will be issued free of charge by the Commissioner of Agriculture to any reputable person having a permanent residence and place of business in this State, provided the applicant agrees to guarantee his seeds according to the method described in rules 11 and 14 following.

4. Every sample and variety of field and garden seed offered for sale in this State shall have attached a label of the form issued by the Commissioner of Agriculture. Said label shall contain the true botanical and common names of the seed and the per cent. of viable seeds and of foreign seeds in the sample and the true and cultural worth of the sample. The determination of genuineness, purity and viability shall be according to the laboratory method adopted by the State Board of Agriculture. (See Rule 14.

5. Seeds kept in stock but not on sale need not be labeled. When a large stock is kept and only a small sample or lot is exposed for sale one label may serve for successive portions taken from the stock bin during a period of three months provided the original lot was certified.

6. Where a mixture of seeds is offered, the true name of each ingredient and its per cent. of the whole must be stated on label, together with the per cent. of the viable seeds of each variety. The Commissioner does not recommend the keeping of mixed seeds in stock since different varieties of seeds deteriorate with different rapidity.

7. No variety of field garden seeds for planting shall be offered for sale in this State if the same shall fall below the following minimum of viability when tested by the official method, to wit:

(See N. C. Agr. Exp. Sta. Bulletin 108, pp. 383, *seq* .)

8. No sample of wheat, oats, barley or rye for planting shall be offered for sale in this State unless the same has been treated for smut and ergot according to the method adopted by the board. See rule 15.

9. No sample of clover, lucerne or vetch for planting shall be offered for sale in this State if the same shall contain more than 1 per mille of fodder.

10. Every person, firm or corporation to deal in field or garden seeds in this State may send to the Department for analyses and certification each year 25 samples without charge. Additional samples will be charged for at following rate:

For a full test of purity and viability,	50c.
For a report as to viability,	25c.
For report as to purity,	25c.
For report as to genuineness,	25c.

Official labels will be supplied at net cost of printing and paper.

11. With every variety and lot of seed sold to a planter the seller shall give the following certificate and guarantee with blanks duly filled up, to wit: This certifies that .... has this .... day of ...., 190.., bought of undersigned .... lbs. of .... seed, botanical name of which is .... The undersigned guarantees that this sample of seed contains not more than ..... per cent. of foreign matter and that it will germinate by the official method ...... per cent. If a cereal, that the seed has been treated for smut or ergot according to the method prescribed by the Commissioner of Agriculture. If the Commissioner of Agriculture reports more than 19 per cent. of foreign matter above this guarantee, or a viability falling more than ..... per cent. below

this guarantee, the undersigned agrees to receive ba'k the seeds and pay the cost of carriage both ways, or to refund a proportionate part of the purchase price at purchaser's option. Provided, the seed is returned or started back within 30 days from but not including date of sale, and further, that no more of the seed is lacking than is required by the State Department of Agriculture, for making a test of this variety.

This guarantee expires also as soon as the seeds are sown.

Signed, ... Address, ...

12. Purchasers of seeds who wish samples tested to verify seller's guarantee must take the sample according to a particular method and fill out a special blank which will be furnished free of cost on application to the Commissioner of Agriculture. Samples not taken by the official method will not be received or tested.

(See sampling blank, circular 34, O. E. S.)

13. Any seed dealer in this State violating these rules will have his license revoked and will be prosecuted to the full extent of the law.

14. All determinations of seed quality under these rules shall be made according to the method recommended by the Association of American Agricultural Experiment Stations and Colleges. (See circular 34 O. E. S.)

15. Cereal seeds for planting must have been tested, before exposing for sale, with copper sulphate, potassium sulphide or formalin.

THE COMPARATIVE VIRULENCE OF THE TUBERCLE BACILLUS FROM HUMAN AND BOVINE SOURCES.*

BY MAZYCK P. RAVENEL, M. D., *Lecturer on Bacteriology, Veterinary Department, University of Pennsylvania; Bacteriologist of the State Live Stock Sanitary Board of Pennsylvania.*

The relation existing between the various types of the tubercle bacillus found in man and in the lower animals, has been the subject of much discussion for several years past, and studies of the morphology, biology, and virulence have been undertaken with the object of determining whether or not constant differences could be detected in the organism from these two sources sufficient to justify their classification as distinct species.

From a purely practical standpoint, the question is narrowed to a study of the bacillus as found in man and in cattle, and in the determination of the relation they bear to each other. The importance of this study is immense, not only to the physician, anxious mainly for the protection of his clients, and to the general public who look to the medical profession for guidance in such matters, but perhaps even more so for those who are concerned in the framing of laws and direction of public measures looking to the suppression of tuberculosis in man and animal. Efforts in this direction often meet with strong opposition, and extreme statements are made on very scanty evidence, which render the task of the hygienist much more difficult, and may result in the failure of his purpose. The lack of positive and authoritative knowledge in regard to this matter has in recent years led to the adoption of retrograde measures in several places. The problem is one that can be entirely cleared up only by a long series of observations and carefully conducted experiments, which are tedious, exacting, and require a considerable lapse of time before results can be had. The correct interpretation of these results is, in many cases, not an easy matter.

The identity of the tubercle bacillus as found in the mammalia went unquestioned for many years, and laws for the prevention of the transmission of the bacillus of cattle to man have been based mainly on this belief. In America, Dr. Theobald Smith was the

*Read before the British Congress on Tuberculosis, Section on Pathology and Bacteriology, London, July 23-26, 1901.

first to take up the systematic study of the bacilli isolated from various of the lower animals and man, and to call attention to certain fairly constant differences observed in the organisms from the two sources which he considers sufficient to justify classifying them as distinct varieties or races, though his experiments "show unmistakably the close relationship existing among the various cultures studied."*

Dr. R. R. Dinwiddie,[2] Pathologist and Bacteriologist of the Arkansas Agricultural Experiment Station (U. S. A.), has carried out quite extensive experiments in which he has compared the virulence of the human and bovine tubercle bacillus, and also human tuberculous sputum with bovine material, for a number of the domestic animals, his results showing a greater power for both the bovine bacillus and material than for the human.

The vast practical importance of the matter, no less than its great scientific interest, was early realized by Dr. Leonard Pearson, State Veterinarian of Pennsylvania, and under his direction we have devoted much of our attention at the laboratory of the State Live Stock Sanitary Board for more than two years past to the study of the tubercle bacillus obtained from various cases of tuberculosis in man and in cattle.

In the carrying out of this work I have had throughout the efficient assistance of Dr. S. H. Gilliland, on whom a large share of the labor has fallen, and to whom is due much of the credit in its successful issue. To him and to the several physicians who have interested themselves in obtaining material for us, I beg to express my obligation. During a considerable portion of the time that Part II of the experiment was in progress, Dr. W. G. Shaw was in charge of the animals, and did much of the work; while the bovine material for the inoculations was obtained and prepared by Dr. J. J. Repp, both of whom were at the time connected with the laboratory.

Our experimental work has been divided into two parts:

1. Isolation and study of pure cultures from various sources in man and cattle.

2. Testing the pathogenic power of tuberculous material of human and bovine origine.

1. Under the first division thirteen cultures, seven of human and six of bovine origin, are included in this report. Of these, two human and two bovine have been compared under conditions as nearly identical throughout at it was possible to obtain them. Cultures H (bovine) and K (human) were isolated within a few days of each other, while L (bovine) and M (human) were made on the same day. The first sub-cultures of both pairs were made on the

same day, and all transfers since have been made simultaneously. The comparative pathogenicity of these cultures is shown in Tables I and II.

Cultures H and K were tested also for puppies and pigs by feeding, as described below.

Culture H was recovered from the horse, goat, two puppies, two hogs, and man; while culture K was recovered only from two puppies and two hogs, the absence of lesions in other animals inoculated making it impossible to obtain a series comparable to culture H. The virulence of these recovered cultures, with the exception of that from the horse, was tested for guinea-pigs and rabbits, the results being given in Table III.

Human cultures I, J, and W, and bovine cultures F, Q, QQ and T, were isolated as occasion arose, and their virulence tested only for guinea-pigs and rabbits. The dose and the mode of inoculation were uniform in all cases, and the animals were kept under the same conditions, but beyond this the tests are not entirely parallel. The results are given in Table IV.

In addition to those cultures here mentioned, we have isolated and examined nine others, morphologically and culturally. These have been taken into account in forming our conclusions, as well as the very careful descriptions given by Dr. Theobald Smith of the cultures studied by him.

The terms "human" and "bovine" have been applied to cultures to denote their origin from man or from cattle. Each culture is designated by a letter of the alphabet, and the generation indicated by a small figure at the lower right corner. Cultures which have been inoculated and recovered retain their original letter, a second letter inclosed in brackets being added to mark the recovered culture.

2. The second part of the work has been the inoculation of animals with tuberculous material from man and cattle. The plan and methods are described in another section, while the results are given in Tables V and VI. As a part of this experiment, human tuberculous sputum has been fed to two calves, and four have been inoculated with the same material. These have been included in Table V, and described farther on.

TABLE I.

TABLE SHOWING VIRULENCE OF BOVINE CULTURE H.

Culture.	Age in days.	Animals.	Date of inoculation.	Method of inoculation.	Dose in c. c.	Initial weight.	Weight at death.	Loss or gain in weight.	Died.	Killed.	Length of life.	Average.
H_2,	15	Guinea-pig, ...	Sept. 2,	Subcutaneous,	1	290 gm.,	174 gm.,	116 gm. loss, .	Sept. 25, ...	....	23 days, ..	28 1-3 days.
H_2,	15	Guinea-pig, ...	Sept. 2,	Subcutaneous,	1	310 gm.,	224 gm.,	86 gm. loss, .	Oct. 9, ...	....	37 days, ..	
H_2,	15	Guinea-pig, ...	Sept. 2,	Subcutaneous,	1	300 gm.,	200 gm.,	100 gm. loss, .	Sept. 27, ...	....	25 days, ..	
H_2,	15	Rabbit, ...	Sept. 2,	Subcutaneous,	1	1,730 gm.,	....	....	Nov. 7, ...	....	66 days, ..	56½ days
H_2,	15	Rabbit, ...	Sept. 2,	Subcutaneous,	1	1,580 gm.,	....	....	Oct. 19, ...	....	47 days, ..	
H_2,	29	Dog, ...	Sept. 16,	Intrapulmon.,	2	20 lbs.,	18 lbs.,	2 lbs. loss, .	Nov. 14, ...	....	59 days, ..	62½ days
H_2,	29	Dog, ...	Sept. 16,	Intrapulmon.,	2	60 lbs.,	....	....	Nov. 21, ...	....	66 days, ..	
H_3,	73	Horse, ...	Dec. 9,	Intrapulmon.,	14	1,030 lbs.,	990 lbs.,	40 lbs. loss, .	....	June 25, '00,	6 m. 16 d.	
H_3,	73	Goat, ...	Dec. 9,	Intrapulmon.,	4	79 lbs.,	61 lbs.,	18 lbs. loss, .	Dec. 31, ...	....	22 days, .	24 days.
H_3,	73	Goat, ...	Dec. 9,	Intrapulmon.,	4	29 lbs.,	20¼ lbs.,	8¾ lbs. loss, .	Jan. 4, '00,	....	26 days, ..	

TABLE SHOWING VIRULENCE OF HUMAN CULTURE K.

Culture.	Age in days.	Animals.	Date of inoculation.	Method of inoculation.	Dose in c. c.	Initial weight.	Weight at death.	Loss or gain in weight.	Died.	Killed.	Length of life.	Average.
K_2,	15	Guinea-pig, ...	Sept. 2,	Subcutaneous,	1	380 gm.,	270 gm.,	110 gm. loss, .	Oct. 14, ...	....	42 days, ..	28 days.
K_2,	15	Guinea-pig, ...	Sept. 2,	Subcutaneous,	1	320 gm.,	175 gm.,	145 gm. loss, .	Sept. 30, ...	....	28 days, ..	
K_2,	15	Guinea-pig, ...	Sept. 2,	Subcutaneous,	1	310 gm.,	215 gm.,	95 gm. loss, .	Oct. 16, ...	....	44 days, ..	
K_2,	15	Rabbit, ...	Sept. 2,	Subcutaneous,	1	1,375 gm.,	1,970 gm.,	595 gm. loss, .	....	May 25, '00,	8 m. 23 d.,	8 m. 23 d.
K_2,	15	Rabbit, ...	Sept. 2,	Subcutaneous,	1	1,500 gm.,	1,820 gm.,	320 gm. gain,	....	May 25, '00,	8 m. 23 d.,	
K_2,	29	Dog, ...	Sept. 16,	Intrapulmon.,	2	21 lbs.,	20 lbs.,	1 lb. loss, .	....	Apr. 20, '00,	7 m. 23 d.,	6 m. 19 d.
K_2,	29	Dog.	Sept. 16,	Intrapulmon.,	2	57 lbs.,	54 lbs.,	3 lbs. loss, .	....	Mar. 19, '00,	7 m. 4 d.,	
K_3,	79	Horse, ...	Dec. 9,	Intrapulmon.,	14	1,275 lbs.,	1,370 lbs.,	95 lbs. gain,	....	June 25, '00,	6 m. 3 d.,	
K_3,	79	Goat, ...	Dec. 9,	Intrapulmon.,	4	73 lbs.,	75 lbs.,	2 lbs. gain.	....	June 29, '00,	6 m. 17 d.	6 m. 21 d.
K_3,	79	Goat, ...	Dec. 9,	Intrapulmon.,	4	28 lbs.,	37 lbs.,	9 lbs. gain,	....	June 29, '00,	6 m. 21 d.,	

TABLE II.

TABLE SHOWING VIRULENCE OF BOVINE CULTURE L.

Culture.	Age in days.	Animals.	Date of inoculation.	Method of inoculation.	Dose in c. c.	Initial weight.	Weight at death.	Loss or gain in weight.	Died.	Killed.	Length of life.	Average.
L_2,	35	Guinea-pig, ...	Dec. 22,	Subcutaneous,	1	330 gm.,	210 gm.,	120 gm. loss, .	Jan. 13, '00,	....	22 days, .	26 2-3 days.
L_2,	35	Guinea-pig, ...	Dec. 22,	Subcutaneous,	1	424 gm.,	240 gm.,	184 gm. loss, .	Jan. 13, '00,	....	22 days, .	
L_2,	35	Guinea-pig, ...	Dec. 22,	Subcutaneous,	1	286 gm.,	246 gm.,	40 gm. loss, .	Jan. 27, '00,	....	[illegible] days, .	
L_2,	35	Rabbit, ...	Dec. 22,	Subcutaneous,	1	1,720 gm.,	1,216 gm.,	504 gm. loss, .	Mar. 17, '00,	....	[illegible] days,	96½ days.
L_2,	35	Rabbit, ...	Dec. 22,	Subcutaneous,	1	2,100 gm.,	1,450 gm.,	650 gm. loss, .	Mar. [illegible], '00,	....	98 days,	
L_2,	35	Dog, ...	Dec. 22,	Intrapulmon.,	3	31 lbs.,	30½ lbs.,	1½ lbs. loss, .	....	Apr. [illegible], '00,	120 days, .	12[illegible] days.
L_2,	35	Dog, ...	Dec. 22,	Intrapulmon.,	3	25½ lbs.,	27 lbs.,	1½ lbs. gain,	....	May 2, '00,	131 days,	
L_2,	[illegible]	Goat, ...	Dec. 23,	Intrapulmon.,	4½	83 lbs.,	73 lbs.,	10 lbs. loss, .	Jan. 8, '00,	....	16 days.	

TABLE SHOWING VIRULENCE OF HUMAN CULTURE M.

Culture.	Age in days.	Animals	Date of inoculation.	Method of inoculation.	Dose in c. c.	Initial weight.	Weight at death.	Loss or gain in weight.	Died.	Killed.	Length of life.	Average.
M_2.	37	Guinea-pig,	Dec. 22,	Subcutaneous,	1	[illegible] gm.,	260 gm.,	90 gm. loss,	Feb. 14, '00,	....	54 days,	34 days.
M_2.	[illegible]	Guinea-pig,	Dec. 22,	Subcutaneous,	1	410 gm.,	300 gm.,	110 gm. loss,	Jan. 13, '00,	....	22 days,	
M_2.	[illegible]	Guinea-pig,	Dec. 22,	Subcutaneous,	1	300 gm.,	216 gm.,	84 gm. loss,	....	....	26 days,	
M_2.	[illegible]	Rabbit,	Dec. 22,	Subcutaneous,	1	1,620 gm.,	1,740 gm.,	120 gm. gain,	....	May 25, '00,	154 days,	154 days.
M_2.	37	Rabbit,	Dec. 22,	Subcutaneous,	1	1,730 gm.,	1,930 gm.,	200 gm. gain,	....	May 25, '00,	154 days,	
M_2.	[illegible]	Dog,	Dec. 22,	Intrapulmon.,	3	29¼ lbs.,	22 lbs.,	7¼ lbs. loss,	Feb. 19, '00,	Apr. 27, '00,	126 days,	92½ days.
M_2.	[illegible]	Dog,	Dec. 22,	Intrapulmon.,	3	21 lbs.,	18½ lbs.,	2½ lbs. loss,	....	....	59 days,	
M_2.	36	Goat,	Dec. 22,	Intrapulmon.,	4½	52 lbs.,	48 lbs.,	4 lbs. loss,	....	June 29, '00,	6 m. 6 d.	

PART I.

ISOLATION AND STUDY OF PURE CULTURES FROM VARIOUS SOURCES IN MAN AND CATTLE.

Method of Isolating Pure Cultures.—The isolation of cultures has been obtained by the method devised by Dr. Theobald Smith,[3] the principal features of which are: (1) The test-tubes, which are fitted with a cap like that of the well known Miquel flask, ground on. The small tubulation in the cap is plugged with glass-wool. (2) The medium, which is dog's serum. The animal is bled with the strictest aseptic precautions, and the blood conducted to sterile jars through sterile rubber tubes. The serum is drawn off with pipettes and distributed at once into the test-tubes, put in the hardening oven, and coagulated at a low temperature (76°C.). Prepared in this way the serum needs no sterilization, and is much softer than when a higher temperature is employed. (3) The tubes are kept always inclined. (4) The tuberculous tissue selected for planting in our culture tubes is not crushed nor rubbed over the surface, as advised in other methods. Young nodules from the omentum, spleen, liver, or a lymphatic gland are cut out, and a block of considerable size is placed on the surface of the serum. After remaining from two to three weeks in the incubator at 37.5° to 39° C., the tissue is pressed against the sides of the tubes with a stout platinum wire, and rubbed over the surface of the medium. Examination of the fluid squeezed out of the tissue at this time will generally indicate the final result. The tubes are replaced in the incubator, and within a week or ten days colonies of the tubercle bacillus usually appear. The nodules for inoculation of the tubes are best obtained from guinea-pigs, which are to be inoculated with the original matter from which we wish to obtain cultures. As soon as these show marked illness they are chloroformed and the cultures made. In general terms, the more recent the lesions the greater the chances of successful culture. As a rule, guinea-pigs can be killed in from three to four weeks after inoculation. If our material is of human origin the inoculation should be intraperitoneal; if bovine, subcutaneous inoculation will generally cause a sufficient rapid involvement of the organs. (5) The incubator should contain a dish of water, to insure an abundance of moisture in the atmosphere. With the same object in view, it should be opened as seldom as possible.

The only modification of the above method in our work has been the addition of a 50 per cent. solution of glycerin in water to the serum in such proportion that the resulting mixture contains 5 per cent. of glycerin. This seems to make coagulation more tardy,

but the serum does not dry out as quickly, and the growth of the tubercle bacillus is facilitated. Serum prepared in this manner has been employed throughout for the cultures used in our inoculations.

Preparation of Cultures for Inoculation, and Dosage.—The course of an experimental tuberculosis depends so largely on the number of bacilli introduced that exact dosage is an important factor in comparative work. Weighing naturally suggested itself, but a trial soon convinced us of its impracticability. The growth of human cultures is usually so abundant by the second generation, that it is easy to obtain fairly dry masses which can be weighed quite accurately, but bovine cultures often grow very scantily for many generations, as a thin film resembling ground glass. We have adopted as a uniform practice the method of Dr. Theobald Smith, the use of a suspension of a given opacity. A portion of the growth is removed to the wall of a dry and sterile test-tube, and rubbed round and round with a glass rod until no lumps can be seen. Bouillon is then added, and after stirring thoroughly, the mixture is allowed to stand quiet for two or three hours, so that the clumps may settle. The upper portion is poured off, and bouillon added until the suspension equals in turbidity a twenty-four-hour-old culture of the typhoid bacillus. The test culture is killed with formalin vapor and sealed, so that it can be used as a standard for a considerable time. Cover-glass preparations were made always as controls. In the tables below the generation of the cultures is indicated by the exponent, and the age of each culture is given in days in a separate column. For guinea-pigs and rabbits the dose has been throughout 1 c.c. of the suspension, introduced under the skin of the abdomen. For the other animals the dose and mode of inoculation are given in the tables.

Morphology and Cultural Characteristics of Bacilli Examined.—The morphology of the bacilli in cultures of bovine origin is more uniform and constant than in cultures from man. The bovine bacilli are short, seldom more than two μ in length, and averaging less. In early generations many are seen which are oval, their length not more than double their breadth. They are thick and straight. They stain with carbol-fuchsin evenly and deeply, and beading is markedly absent, even in old cultures.

The human bacilli are, as a rule, much longer from the start, and tend to increase in length rapidly in sub-cultures. They are generally more or less curved and some cultures contain many S-shaped forms, as culture M noted above. They stain with carbol-fuchsin less deeply, and beading is a marked characteristic, often seen in the earliest growth.

These characteristics are most persistent in cultures on blood-

serum. On glycerin agar, glycerin bouillon and potato with glycerin, the bacilli from the two sources approach each other in appearance and morphology much more closely.

The human cultures isolated have without exception grown more luxuriantly than the bovine cultures, though in at least two instances (cultures U and BB) the first growth was very long in appearing. This was due no doubt to their feeble virulence and consequent slow production of lesions in the tissues of guinea-pigs. A saprophytic life once established, they grew vigorously.

The bovine cultures are apt to grow as discrete colonies in the first culture, and for several generations are likely to grow as an exceedingly thin layer over a part of the medium, resembling closely ground glass.

The human bacillus can usually be induced to grow on glycerin agar in sub-cultures made from the original growth on blood-serum. All attempts to obtain a like result with the bovine organism have failed.

Three of the bovine cultures examined have been isolated from milk. Two of these, L and Q, have shown throughout the characters of the type described as "bovine," while T approaches the human bacillus in morphology, being long and slender. It is, however, more virulent than any human culture tested.

Among the human cultures, only one (M) has been isolated from sputum. Through the kindness of Dr. Alfred Hand, Pathologist of the Children's Hospital, to whom we beg to make grateful acknowledgments, we have been able to obtain cultures from three cases of tuberculosis in young children in which the intestine was involved. One of these, from which culture BB was isolated, was considered by Dr. Hand to be "more clearly than any other he had ever seen, of intestinal origin," and was therefore studied with peculiar interest. Its pathogenicity has not yet been determined, but the course of the disease in the guinea-pigs inoculated to obtain the culture indicated a very feeble virulence, one living sixty-six and another ninety-six days. The bacilli, even in the first generation, are unusually long and thick. They stain deeply with cabol-fuchsin, but are beaded in a striking manner, the brightly stained portions being quite regularly disposed along the rod. They are most unlike what we have described as the bovine type in every way.

Cultures U and W, also from children with intestinal lesions, correspond to the human type in every particular, both as regards morphology and virulence.

COMPARISON OF CULTURES H (BOVINE) AND K (HUMAN).

History of Cultures.—Culture H (bovine) was isolated from the mesenteric gland of a Jersey grade cow about seven years old, which had been slaughtered for beef, but found to be extensively diseased

and condemned. The lungs were the seat of an extensive and long continued tuberculosis. Most of the foci had undergone caseation. The liver was involved also, but to a less extent. The gland from which the culture was obtained had undergone cheesy degeneration. On May 17, 1899, guinea pigs were inoculated intraperitoneally with an emulsion made from the centre of this gland. On July 6 one pig was killed and cultures made on dog's serum. On July 28 the first growth was observed, and on August 18 sub-cultures were made from the omentum. Growth was fairly abundant. The bacilli were short, thick, straight and stained evenly and deeply.

Culture K (human) was isolated from the lung of an adult negro man. The disease was not severe and was confined almost entirely to the lungs. Death was due to heart trouble. Guinea-pigs were inoculated intraperitoneally with an emulsion made from nodules taken from the lungs on June 10, 1899. On June 28, a pig was killed and cultures made on dog's serum. Growth was first observed on July 29, the cultures from the spleen being used for sub-cultures, the first of which was made on August 18. This culture grew rapidly and abundantly from the beginning. The bacilli were quite long, slender and curved. They stained somewhat faintly, and showed a marked tendency to beading.

COMPARISON OF CULTURES L (BOVINE) AND M (HUMAN).

History of Cultures.—Culture L (bovine) was obtained from the milk of a cow with tuberculosis of the udder. On May 22, 1899, a guinea-pig was inoculated with 10 c. c. of this milk. It died July 8, and from it a second guinea-pig was inoculated intraperitoneally with an emulsion made from the spleen and omentum. On August 25 this pig was killed and two others inoculated intraperitoneally with an emulsion from the spleen and omentum. One of these was killed on September 18, and cultures made on dog's serum. On October 20 growth was first observed. On November 17 sub-cultures were made. The growth for several generations was very scanty. The bacilli were extremely short, many oval in shape. They took the stain evenly and deeply.

Culture M (human) was obtained from the sputum of a young adult female. Throat symptoms were most marked in this case. The disease was rapid and violent, death occurring in about five weeks after the sample of sputum was obtained. It contained large numbers of tubercle bacilli. On July 12, 1899, a guinea-pig was inoculated subcutaneously with the sputum. It was killed August 25, and two pigs inoculated intraperitoneally with an emulsion made from the spleen and omentum. On September 18 a pig was killed and cultures made on dog's serum. Growth was first observed on October

15, and sub-cultures were made on October 17. Growth was rapid and abundant from the first, and the first transfers made from the original culture to glycerin agar, grew luxuriantly. The bacilli in the original culture were rather short, irregular in shape, many S-shaped, and as a rule stained quite evenly and deeply. In sub-cultures the bacilli soon became much longer, straighter and showed beading.

Summary and Postmortem Notes.—It will be seen from the above tables that for each culture ten animals were used. Of the ten inoculated with culture H (bovine), nine died, while only one had to be killed, this being the horse; while of those inoculated with culture K (human) only three died, while seven had to be killed. With each of cultures L (bovine) and M (human) eight animals were inoculated. Of those inoculated with culture L, six died and two were killed; while for culture M four died and four were killed. Taking the totals of these four cultures, eighteen animals were used for the bovine cultures and eighteen for the human. Of those inoculated with bovine tubercle bacillus, fifteen died and three were killed; while of those inoculated with the human cultures, seven died and eleven were killed. By making a closer study of the tables, further differences in virulence between the bovine and human cultures may be brought out. All the guinea-pigs inoculated with those four cultures died, the extent of the postmortem lesions being practically identical in all of them. Those inoculated with the human culture K lived almost ten days longer than those inoculated with the bovine culture H; while those inoculated with human culture M lived seven and one-third days longer than those inoculated with bovine culture L. All the rabbits inoculated with both of the human cultures had to be killed and showed no postmortem lesions whatever, while those inoculated with the bovine cultures died, with extensive lesions. These lesions varied somewhat in the different animals, necrotic areas at the point of inoculation, and complete involvement of the lungs being common to them all. The kidneys were also generally involved. Only one animal had generalized tuberculosis, involving the lungs, liver, kidneys, spleen and omentum.

Dogs.—The dogs showed a varying degree of susceptibility to all the cultures. Both of those inoculated with bovine culture H died, one in fifty-nine days, the other in sixty-six days. The smaller of the two had shown signs of illness for some days before death. The point of inoculation was well marked in the lung by a mass of tubercles 2.5 cm. in diameter. Both lungs were infiltrated throughout with gray nodules from 2 mm. to 4 mm. in diameter. Both pleural cavities contained a considerable amount of purulent effusion. The right pleura was roughened, without adhesions. The outer surface of the pericardium was thickly sown with minute nodules about 2

mm. in diameter, its interior being smooth. The liver was infiltrated throughout and necrotic, giving a nutmeg appearance. The right kidney contained a number of tubercular nodules; the left was congested, but otherwise normal. The spleen had escaped infection. Through an accident no postmortem was obtained of the other dog, but from his symptons for some days before death it is reasonably certain that the disease was general, affecting particularly, perhaps, the lungs. Both of the dogs inoculated with human culture K had to be killed, the lesions in both being insignificant. In one the only marked change which could be found corresponded to the point of inoculation in the lung, where a small excavation was found almost completely filled in with scar tissue, radiating from the centre in star shape. Scrapings from cut surfaces of this area revealed the presence of tubercle bacilli. All other organs were entirely normal. In the other dog the point of inoculation was marked by a large nodule in the pleural surface of the lung. The surfaces of both lungs showed a great number of minute nodules. Scrapings from cut surfaces revealed tubecle bacilli in small numbers. On the external surface of the pericardium was a nodule about one inch in diameter which contained calcareous foci, incapsulated in dense fibrous material. The mediastinal glands were enlarged and contained a number of caseous foci. In all other respects the animal seemed normal.

Horses.—A marked difference was noted in the effect of the cultures on the horses. The horse inoculated with bovine culture H showed no ill effects from the injection for some months after the injection. In the latter part of March, nearly four months after the injection, some emaciation could be noted, and the respiration was quickened, being on an average of twenty-two a minute and somewhat labored. On the first of April the temperature averaged 102.2 degrees Fahrenheit. The symptoms grew very slightly more marked and on June 25, six months and a half after inoculation, the animal was killed. It had lost forty pounds in weight, though its condition was still fair. The costal pleurae were extensively covered with masses of nodules of from 2 mm. to 18 mm. in diameter, averaging nearly 12 mm. in thickness. These growths were somewhat more extensive on the left side than on the right, and tended to be more isolated and somewhat larger in size. The lungs were a grayish pink, the blood-vessels being plainly outlined in a delicate network over the surface. They were covered with nodules, varying from 1 mm. up to 6 mm. of an inch in size, and closely packed. Both lungs were hard, dense and devoid of elasticity, having much the feel of liver. At the point of inoculation on the right lung a small depression was found, filled in with a star shaped cicatrix. This cicatricial tissue was surrounded with a nodule about 2.5 cm. in diameter, containing cheesy areas and much fibrous tissue. In the posterior part

of the left lung a tubercular abscess about 2.5 cm. in diameter was found, and in the bottom of the lung several similar in size and character were seen. The bronchial glands were enlarged to twice their normal size, but showed no caseation. The surface of the pericardium was studded with minute nodules. The thoracic surface of the diaphragm was covered over a large portion of its surface with nodules the size of a pea, some of them pedunculated. Among the nodules were many shreds of fibrin, some of them 2.5 cm. in length. Similar masses were seen also on the costal surface of the lung. The liver, spleen and kidneys appeared normal.

The horse inoculated with human culture K showed no clinical evidence of injury. The first of April its respiration was twelve a minute, its temperature was 100.5 degrees Fahrenheit. It was killed on June 25, about six months and a half after inoculation. Its condition was good. It had gained ninety-five pounds in weight. There was considerable fat subcutaneously, and about the abdominal organs. All of the abdominal organs were entirely normal, with the exception of the liver, on the surface of which many fringes of fibrin were found. In the thoracic cavity both pleurae were smooth and shiny, except at the point of inoculation on the side right, where a mass of small nodules, with fringes of fibrin were seen. At the point of inoculation in the right lung was a cheesy abscess 4 cm. in diameter, and incapsulated with dense fibrous tissue, the walls being 6 mm. thick. Otherwise, the lung was entirely normal. In the left lung were three small tuberculous nodules about 12mm. in diameter, situated near the surface, and which had undergone caseation. The disease was evidently non-progressive, and was probably retrogressive.

Goats.—Both the goats inoculated with bovine culture H died, one in twenty-two days and the other in twenty-six days, the lesions being much the same in both. There was thickening of the pleurae and adhesion at the point of inoculation; otherwise they were normal. The lungs were covered with myriads of minute tubercles about 1 mm. in diameter, which gave a gritty feel to them. In the substance of the lung no tubercles could be found. The cut surfaces presented a pneumonic appearance, most marked in the smaller of the two animals. Scrapings from cut surfaces in any portion of the lung revealed enormous numbers of tubercle bacilli. The mucus in the bronchial tubes throughout the lungs also contained large numbers of tubercle bacilli. In the larger animal the liver, spleen, kidneys, peritoneum and diaphragm were normal. The animal lost eighteen pounds in weight in the twenty-two days of its life after inoculation. The smaller goat showed involvement of the abdominal organs also. The omentum was studded with pearly tubercles 2 mm in diameter, one of which had undergone caseation. The surface of

the spleen was thickly covered with tubercles 1 mm. in diameter. In the substance of the spleen no nodules could be found, but scrapings from cut surfaces showed a large number of tubercle bacilli. The liver shewed no microscopic tubercles, but scrapings from cut surfaces were rich in bacilli, and in sections under the microscope tubercles were seen, with a few giant cells. Microscopic examination of the lungs, however, revealed no tubercles. The infection in this animal was diffuse, and it is considered as a case of tubercular septicemia.

Both of the goats inoculated with human culture K gained in weight and were killed after six months and twenty-one days. Both were in good condition, having a considerable amount of fat in the subcutaneous tissues and around the abdominal organs. In the larger animal at the point of inoculation there was an area of adhesion to the pleura about 8 mm. in diameter. On the surface of the left lung were two or three nodules about 3 mm. in diameter which had undergone caseation. This lung is attached at its lower edge to the diaphragm by fringes of fibrin, and along this edge a few nodules about 12 mm. in diameter and containing cheesy pus were found. The entire surface of the left lung was covered with fringes of fibrin of a reddish-pink color. In both lungs the elasticity was preserved and neither revealed nodules either by palpation or on section. The left pleura was covered with a network of fibrin similar to that seen in the lung; the right was normal. The mediastinal glands were much enlarged and calcareous. In the liver two small nodules were found near the surface, the organ geing otherwise normal. In the smaller animal the omentum contained upwards of a hundred nodules from 2 to 12 mm. in diameter. The left lung was attached to the pleura at its edge by numerous bands of fibrin and at its posterior surface to the diaphragm in the same manner. Along the lower border were a number of nodules about 6 mm. in diameter which had undergone caseation. The right lung was normal. The mediastinal glands were enlarged and calcareous. The left pleura shows ten or twelve nodules 6 mm. in diameter, which are cheesy; besides a large one, corresponding to the point of inoculation. The diaphragm is attached to the spleen and to the stomach by bands of fibrin, but no nodules were found. The liver was normal; the portal glands were enlarged and contained many cheesy nodules. The left kidney contained a number of cheesy nodules. The right kidney was normal. The mesenteric glands were enlarged and several of them contained calcareous areas.

COMPARATIVE VIRULENCE OF BOVINE CULTURE H AND HUMAN CULTURE K FOR PUPPIES AND PIGS WHEN INTRODUCED THROUGH THE ALIMENTARY TRACT.

Puppies.—Four puppies eight weeks old, from the same litter, were selected, two of which received a suspension of milk of bovine culture H and two a similar suspension of human culture K, equal amounts being given on ten days, six days in succession, with an interval of seven days, then four days in succession. The regular food was sterilized milk, bread and boiled beef.

Only one of the four puppies died, one of the two which received the human culture K, death occurring after fifty-seven days. There was a generalized tuberculosis, most marked in the lungs and liver. The other puppy was killed after eighty five days. The only lesions found were small cheesy nodules on surface of one lung, in parotid and mesenteric glands.

The two puppies fed with bovine culture H showed no ill effects whatever, and were killed on the eighty-fifth and eighty-seventh days, respectively. Both were in good condition, the only lesions found being in the parotid and mesenteric glands, which contained minute caseous areas, none larger than 2 mm. in diameter.

Pigs.—As with the puppies, four pigs from the same litter, eight weeks old, were taken, two being fed with human culture K, and two with bovine culture H, equal amounts of a suspension in sterile water being soaked into bread and given for ten days with an intermission of only one day. The regular food was sterilized milk, ground oats, bran and cornmeal.

All four of the pigs died, the average life of the two fed with human bacilli being one hundred and eighteen and a half days against one hundred and a half days for the two which received the bovine culture. One pig of each pair lived one hundred and twenty-three days, dying on the same day. The total difference in gain of weight was only half a pound. All showed, postmortem, a generalized tuberculosis.

While some differences were noticed in the extent of the disease in various organs, it cannot be said that these were such as to indicate a greater virulence of one culture than the other. In all the mesenteric glands were extensively diseased, while in one only, fed with bovine bacilli, was there ulceration of the mucous membrane of the intestine. Three of the four showed tuberculous ulceration of the tonsils. The remaining one presented no gross changes in this gland, but, microscopically, areas of necrosis, apparently in the lymp-follicles, were found, and sections stained with carbol-fuchsin revealed large numbers of tubercle bacilli. The two pigs which lived longest, one bovine and one human, both had extensive involvement

TABLE III.

TABLE SHOWING VIRULENCE OF BOVINE CULTURE H AND HUMAN CULTURE K FOR RABBITS AND GUINEA-PIGS, AFTER RECOVERY FROM ORIGINAL ANIMAL.

Culture.	Recovered from.	Age in days.	Animals.	Date of inoculation.	Initial weight.	Weight at death.	Loss or gain in weight.	Died.	Killed.	Length of life.	Average.
H $(A)_3$, ...	Goat, ...	22	Guinea-pig, ...	June 19,	360 gm.,..	225 gm.,..	135 gm. loss,..	July 26,	....	37 days,...	
H $(A)_3$, ...	Goat, ...	22	Guinea-pig, ...	June 19,	420 gm.,..	....	....	July 13,	....	24 days,...	27 1-3 days.
H $(A)_3$, ...	Goat, ...	22	Guinea-pig, ...	June 19,	410 gm.,..	....	....	July 10,	....	21 days,...	
H $(B)_2$, ...	Puppy, ...	42	Guinea-pig, ...	May 28,	280 gm.,..	220 gm.,..	60 gm. loss,..	July 2,	....	35 days,...	
H $(B)_2$, ...	Puppy, ...	42	Guinea-pig, ...	May 28,	360 gm.,..	210 gm.,..	150 gm. loss,..	June 23,	....	26 days,...	28 1-3 days.
H $(B)_2$, ...	Puppy, ...	42	Guinea-pig, ...	May 28,	260 gm.,..	184 gm.,..	76 gm. loss,..	June 21,	....	24 days,...	
H $(C)_2$, ...	Puppy, ...	41	Guinea-pig, ...	May 28,	310 gm.,..	210 gm.,..	100 gm. loss,..	July 2,	....	35 days,...	
H $(C)_2$, ...	Puppy, ...	41	Guinea-pig, ...	May 28,	295 gm.,..	210 gm.,..	85 gm. loss,..	June 29,	....	32 days,...	34 days.
H $(C)_2$, ...	Puppy, ...	41	Guinea-pig, ...	May 28,	308 gm.,..	230 gm.,..	78 gm. loss,..	July 20,	....	33 days,...	
H $(D)_2$, ...	Hog, ...	36	Guinea-pig, ...	Aug. 4,	562 gm.,..	380 gm.,..	182 gm. loss,..	Sept. 8,	....	35 days,...	
H $(D)_2$, ...	Hog, ...	36	Guinea-pig, ...	Aug. 4,	530 gm.,..	260 gm.,..	270 gm. loss,..	Sept. 7,	....	34 days,...	33 days.
H $(D)_2$, ...	Hog, ...	36	Guinea-pig, ...	Aug. 4,	470 gm.,..	270 gm.,..	200 gm. loss,..	Sept. 3,	....	30 days,...	
H $(E)_2$, ...	Man (S. H. G.),	27	Guinea-pig, ...	Aug. 2,	460 gm.,..	260 gm.,..	200 gm. loss,..	Aug. 29,	....	27 days,...	
H $(E)_2$, ...	Man (S. H. G.),	27	Guinea-pig, ...	Aug. 2,	640 gm.,..	400 gm.,..	240 gm. loss,..	Sept. 3,	....	32 days,...	26 1-3 days.
H $(E)_2$, ...	Man (S. H. G.),	27	Guinea-pig, ...	Aug. 2,	536 gm.,..	370 gm.,..	166 gm. loss,..	Aug. 22,	....	20 days,...	
H $(F)_2$, ...	Hog, ...	38	Guinea-pig, ...	Sept. 13,	610 gm.,..	370 gm.,..	240 gm. loss,..	Oct. 29,	....	46 days,...	
H $(F)_2$, ...	Hog, ...	38	Guinea-pig, ...	Sept. 13,	330 gm.,..	240 gm.,..	90 gm. loss,..	Oct. 22,	....	39 days,...	40 days.
H $(F)_2$, ...	Hog, ...	38	Guinea-pig, ...	Sept. 13,	250 gm.,..	200 gm.,..	50 gm. loss,..	Oct. 18,	....	35 days,...	
H $(A)_3$, ...	Goat, ...	22	Rabbit, ...	June 19,	2,030 gm.,..	1,680 gm.,..	350 gm. loss,..	July 18,	....	29 days,...	53 days.
H $(A)_3$, ...	Goat, ...	22	Rabbit, ...	June 19,	1,800 gm.,..	1,380 gm.,..	420 gm. loss,..	Sept. 4,	....	77 days,...	
H $(B)_2$, ...	Puppy, ...	42	Rabbit, ...	May 28,	1,455 gm.,..	1,390 gm.,..	65 gm. loss,..	Aug. 28,	....	92 days,...	84½ days.
H $(B)_2$, ...	Puppy, ...	42	Rabbit, ...	May 28,	1,975 gm.,..	1,180 gm.,..	795 gm. lass,..	Aug. 13,	....	77 days,...	
H $(C)_2$, ...	Puppy, ...	41	Rabbit, ...	May 28,	1,770 gm.,..	1,050 gm.,..	720 gm. loss,..	Aug. 11,	....	75 days,...	78½ days.
H $(C)_2$, ...	Puppy, ...	41	Rabbit, ...	May 28,	1,818 gm.,..	1,270 gm.,..	548 gm. loss,..	Aug. 18,	....	82 days,...	
H $(D)_2$, ...	Hog, ...	36	Rabbit, ...	Aug. 4,	....	910 gm.,..	....	Sept. 12,	....	39 days,...	65 days.
H $(D)_2$, ...	Hog, ...	36	Rabbit, ...	Aug. 4,	....	805 gm.,..	....	Nov. 3,	....	91 days,...	
H $(E)_2$, ...	Man (S. H. G.),	27	Rabbit, ...	Aug. 2,	2,510 gm.,..	1,625 gm.,..	884 gm. loss,..	Oct. 29,	....	87 days,...	61½ days.
H $(E)_2$, ...	Man (S. H. G.),	27	Rabbit, ...	Aug. 2,	1,870 gm.,..	1,620 gm.,..	250 gm. loss,..	Sept. 7,	....	36 days,...	
H $(F)_2$, ...	Hog, ...	38	Rabbit, ...	Sept. 13,	1,530 gm.,..	1,190 gm.,..	340 gm. loss,..	Nov. 12,	....	60 days,...	63 days.
H $(F)_2$, ...	Hog, ...	38	Rabbit, ...	Sept. 13,	840 gm.,..	940 gm.,..	100 gm. gain,..	Nov. 18,	....	66 days,...	

K (B)$_2$, ...	Puppy, ...	39	Guinea-pig, ...	May 28,	315 gm.,..	280 gm.,..	35 gm. loss,..	Aug. 16,	....	80 days,...	
K (B)$_2$, ...	Puppy, ...	39	Guinea-pig, ...	May 28,	310 gm.,..	270 gm.,..	40 gm. loss,..	July 26,	....	59 days,...	63 days.
K (B)$_2$, ...	Puppy, ...	39	Guinea-pig, ...	May 28,	330 gm.,..	240 gm.,..	90 gm. loss,..	July 17,	....	50 days,...	
K (C)$_2$, ...	Puppy, ...	42	Guinea-pig, ...	May 29,	380 gm.,..	220 gm.,..	160 gm. loss,..	July 27,	....	59 days,...	
K (C)$_2$, ...	Puppy, ...	42	Guinea-pig, ...	May 29,	440 gm.,..	280 gm.,..	160 gm. loss,..	July 18,	....	50 days,...	48 days.
K (C)$_2$, ...	Puppy, ...	42	Guinea-pig, ...	May 29,	390 gm.,..	220 gm.,..	170 gm. loss,..	July 3,	....	35 days,...	
K (D)$_2$, ...	Hog, ...	29	Guinea-pig, ...	Aug. 7,	530 gm.,..	....	....	Sept. 8,	....	32 days,...	
K (D)$_2$, ...	Hog, ...	29	Guinea-pig, ...	Aug. 7,	390 gm.,..	330 gm.,..	60 gm. loss,..	Sept. 3,	....	27 days,...	29½ days.
K (E)$_2$, ...	Hog, ...	38	Guinea-pig, ...	Sept. 13,	350 gm.,..	220 gm.,..	130 gm. loss,..	Oct. 16,	....	33 days,...	
K (E)$_2$, ...	Hog, ...	38	Guinea-pig, ...	Sept. 13,	320 gm.,..	260 gm.,..	60 gm. loss,..	Oct. 9,	....	26 days,...	32 1-3 days.
K (E)$_2$, ...	Hog, ...	38	Guinea-pig, ...	Sept. 13,	310 gm.,..	220 gm.,..	90 gm. loss,..	Oct. 21,	....	38 days,...	
K (B)$_2$, ...	Puppy, ...	39	Rabbit, ...	May 28,	1,445 gm.,..	1,360 gm.,..	85 gm. loss,..	Aug. 28,	....	92 days,...	
K (B)$_2$, ...	Puppy, ...	39	Rabbit, ...	May 28,	1,685 gm.,..	1,610 gm.,..	75 gm. loss,..	Sept. 21,	....	116 days,...	104 days.
K (C)$_2$, ...	Puppy, ...	42	Rabbit, ...	May 29,	1,560 gm.,..	2,010 gm.,..	450 gm. gain,..	....	Oct. 4,	128 days,...	
K (C)$_2$, ...	Puppy, ...	42	Rabbit, ...	May 29,	1,560 gm.,..	2,610 gm.,..	1,050 gm. gain,..	....	Oct. 4,	128 days,...	128 days.
K (D)$_2$, ...	Hog, ...	21	Rabbit, ...	Aug. 7,	....	....	....	Oct. 1,	....	55 days,...	
K (D)$_2$, ...	Hog, ...	21	Rabbit, ...	Aug. 7,	....	....	....	Nov. 3,	....	88 days,...	71½ days.
K (E)$_2$, ...	Hog, ...	38	Rabbit, ...	Sept. 13,	1,260 gm.,..	1,290 gm.,..	30 gm. gain,..	Nov. 3,	....	51 days,...	
K (E)$_2$, ...	Hog, ...	38	Rabbit, ...	Sept. 13,	1,050 gm.,..	855 gm.,..	195 gm. loss,..	Nov. 26,	....	74 days,...	62½ days.

of the joints, so that for several weeks before death walking was almost impossible.

The result of this experiment is inconclusive as far as the puppies are concerned, except as showing that they are readily infected through the alimentary tract. The pigs showed practically an equal susceptibility to the two cultures. The ease with which they were infected, and the extent of the lesions produced in so short a time, were both striking features, and should serve to put farmers on their guard against feeding their swine on milk from tuberculous cattle. In Pennsylvania we have observed several instances in which neglect of this precaution has led to considerable loss.

The cultures included in Table III were all recovered from animals which had been inoculated or fed with cultures H and K. Their virulence was tested only for rabbits and guinea-pigs. The most striking thing to be noticed in the results is the increase in virulence in the human bacillus recovered from the hogs K (D) and K (E). The average length of life for guinea-pigs after inoculation with the original culture K was thirty-eight days, while the rabbits were killed after eight months and twenty-three days, showing successfully resisted infection. On the other hand, the culture recovered from the hogs killed guinea pigs in twenty-nine and one-half and thirty-two and one-third days, and rabbits in seventy-one and one-half days respectively, showing a virulence for those animals which corresponds to that seen in bovine cultures.

Culture H (E) was recovered from a nodule on the hand of Dr. S. H. G., who accidentally inoculated himself while making a post-mortem on one of the goats which had succumbed to the original culture H. Particular interest attaches therefore to this culture. No marked difference can be detected in the virulence of this culture as compared with the original.

Considerable difference has been noted in the readiness with which the recovered cultures grew in the early generations. H (A), H (B), H (D) and H (F) all grew vigorously from the start, the three last growing without any stirring of the tissue on the original tubes, while H (G) grew on tubes sealed with paraffin, a result which I have been able to obtain only with the human bacillus, with this exception. The morphology of all the recovered cultures correspond closely to the original.

COMPARISON OF OTHER HUMAN AND BOVINE CULTURES.

HISTORY OF CULTURES.

Culture F (*Bovine*).—Obtained from a large tumor on the diaphragm of a cow which had been slaughtered for beef. The tumor was 13 cm. long and from 7 to 9 cm. in diameter. On the surface were a number of grape-like masses of pearly lustre. On section numerous caseous areas were found, from which an emulsion was made. It contained many tubercle bacilli. A guinea-pig was inoculated intraperitoneally May 16, 1899. Death occurred on June 8, and from its tissues a second pig was inoculated intraperitoneally. This pig was chloroformed July 31, and a third pig inoculated in the same manner, which was chloroformed August 21, and cultures made from spleen and omentum. Scanty growth was observed on September 27. Under the microscope the bacilli were thick, short and showed little tendency to beading, staining deeply and uniformly. The further history of this culture is given in the paragraph on "Retention of Characteristics in Culture."

Culture Q (*Bovine*).—Obtained from the lungs of cow No. 5986. This cow was brought to our department on July 6, 1898, for experimental purposes, being considered then an advanced case of tuberculosis. She was emaciated and coughing badly. Many tubercle bacilli were found in the mucus she coughed up, which were long, thin and much beaded. She died February 12, 1900. The lungs were infiltrated throughout, many of the areas having undergone caseation and calcification. It was difficult to understand how the animal lived as long as it did. The mediastinal glands formed a tumor 35 cm. long by 15 cm. in diameter, which was cheesy on section. The mesenteric glands were enlarged and cheesy. A guinea-pig was inoculated in the peritoneal cavity on November 15, 1889. On November 30 the animal was killed and cultures made. Growth was observed first on January 10, and sub-cultures made on the same date. Growth was always scanty.

Culture QQ (*Bovine*).—Was obtained from the mesenteric gland of cow No. 5986. An emulsion from the centre of the gland was inoculated into the peritoneal cavity of a guinea-pig February 13, 1900. On March 5 it was chloroformed and cultures made. Growth was observed on April 12, and sub-cultures were made on April 17. Growth was more abundant than that on the preceding culture (Q), but still scanty.

Culture T (*Bovine.*)—Was obtained from milk sent in for examination by a dairyman in Philadelphia. It was inoculated into the peritoneal cavity of a guinea-pig January 24, 1900. The guinea-pig

was chloroformed on April 6. With an emulsion of its spleen two other guinea-pigs were inoculated intraperitoneally on the same date. One of these was chloroformed on April 28, and cultures made. Growth was observed first on June 23, and cultures made the same day. Growth was abundant and luxuriant.

Culture U (Human).—Obtained from a child three years of age, whose death was due to tubercular meningitis. Autopsy. Lungs and bronchial lymphatic glands full of miliary tubercles. Anterior mediastinal glands much enlarged. Spleen extensively involved, liver less so. On abdominal surface of diaphragm were a number of flat, yellow nodules. Mesenteric glands enlarged, and contained old, yellow, cheesy nodules. One small tubercle found in right suprarenal. Purulent and cheesy nodules found in meninges and encephalon. The culture was obtained from mesenteric glands.

The pathologist, Dr. Hand was uncertain as to the origin of this case.

Guinea-pigs were inoculated intraperitoneally on June 15, 1900. One was killed on July 23, and with its tissues a second was inoculated intraperitoneally. This was chlorformed on September 12, and cultures made. On October 11, no growth having taken place, the blocks of tissue were transferred to fresh serum and stirred. On December 4 growth was first observed, and on December 15 sub-cultures were made. Growth has been rapid and abundant.

Culture W (Human).—Obtained from a child nine months of age, of scrofulous parentage. The cervical glands on both sides were enlarged. Autopsy. A double broncho-pneumonia was found. One small tubercular nodule was found on surface of left lung, several at apex of right lung. Bronchial glands not enlarged. Tonsils normal in size, but glands on each side of pharynx extending in front of and behind sternomastoid muscle were enlarged, tuberculous, and several contained creamy pus. Three mesenteric glands were enlarged and cheesy; an ulcer was found in the jejunum and another at the ileocecal valve. Peyer's patches and the lymphatic glands about cecum were enlarged. Spleen and liver contained tubercles. The mesenteric glands were employed for the isolation of the culture.

This case was considered by Dr. Hand as being probably of tonsillar or pharyngeal origin.

Guinea-pigs were inoculated intraperitoneally on October 5, 1900. From one which died on January 4, 1901, a second was inoculated intraperitoneally. This was killed March 4, and cultures made. Growth was first observed on April 12, and sub-cultures made the following day.

Culture BB (Human).—Obtained from a child seventeen months of age. Death was due to tubercular meningitis. Autopsy. Lungs

normal, except posterior and part of right upper lobe, which was consolidated, red on section, and had excess of connective tissue. Bronchial and mediastinal glands not enlarged. Spleen, liver and kidneys show pearly tubercles. Two feet from lower end of ileum is an ulcer 1 by 2 cm., the long diameter transverse to axis of gut. Nodules are seen on peritoneal surface. Four small ulcers, two above and two below, are found in ileum. Mesenteric glands enlarged, cheesy and some purulent. Meninges show yellow tubercles most marked along longitudinal fissure, in choroid plexus, and over cerebellum. The mesenteric glands were used in obtaining the culture.

This case is considered by Dr. Hand the clearest one of primary intestinal tuberculosis ever seen by him.

Guinea-pigs were inoculated intraperitoneally with an emulsion made from the mesenteric glands on March 9, 1901. One was chloroformed on April 19 and cultures made. Scanty growth on one tube was found June, and sub-cultures made.

The results given in Table IV show for all the bovine cultures a greater virulence than for any of the human cultures. The average life of the guinea-pigs inoculated with human bacilli was more than twice that of those inoculated with bovine. All the rabbits which received human cultures gained in weight and had finally to be killed, while for the bovine they died, and presented postmortem extensive lesions, the lungs and kidneys being the chief seats of the disease in all animals.

PART II.

TESTING THE PATHOGENIC POWER OF TUBERCULOUS MATERIAL OF HUMAN AND BOVINE ORIGIN.

In addition to the study of a number of pure cultures obtained from man and cattle, we have examined the pathogenic power of tuberculous material from the two sources also, making a series of inoculations which are as nearly parallel as possible. The results of these tests are shown in Tables V and VI. The plan was to inoculate a series of animals with tuberculous tissues rubbed into a smooth suspension, and at the same time to inoculate a number of guinea-pigs with the same, which on their death would furnish material for another series of inoculations parallel with those made directly from the human and bovine tissues. It was believed that the material from guinea-pigs would more nearly represent pure cultures of the respective organisms than would be obtained from the

TABLE IV.

TABLE SHOWING VIRULENCE OF THE TUBERCLE BACILLUS FROM VARIOUS SOURCES FOR RABBITS AND GUINEA-PIGS.

Culture.		Age in days.	Animal.	Initial weight.	Weight at death.	Loss or gain in weight.	Date of inoculation.	Died.	Killed.	Length of life.	Average.
J_6,	Human,	20	Guinea-pig,	610 gm.,	370 gm.,	240 gm. loss,	July 16,	Sept. 24,	....	77 days,	
J_6,	Human,	20	Guinea-pig,	514 gm.,	320 gm.,	194 gm. loss,	July 16,	Oct. 1,	....	77 days,	79 2-3 days
J_6,	Human,	20	Guinea-pig,	434 gm.,	310 gm.,	124 gm. loss,	July 16,	Oct. 16,	....	92 days,	
J_6,	Human,	20	Rabbit,	920 gm.,	1,450 gm.,	530 gm. gain,	July 16,	....	Dec. 19,	156 days,	
J_6,	Human,	20	Rabbit,	855 gm.,	1,470 gm.,	615 gm. gain,	July 16,	....	Dec. 19,	156 days,	156 days.
I_6,	Human,	32	Guinea-pig,	695 gm.,	510 gm.,	185 gm. loss,	July 16,	Aug. 4,	....	19 days,	
I_6,	Human,	32	Guinea-pig,	700 gm.,	420 gm.,	280 gm. loss,	July 16,	Sept. 12,	....	58 days,	54 1-3 days.
I_6,	Human,	32	Guinea-pig,	454 gm.,	360 gm.,	94 gm. loss,	July 16,	Oct. 10,	....	86 days,	
I_6,	Human,	32	Rabbit,	900 gm.,	1,850 gm.,	950 gm. gain,	July 16,	....	Dec. 19,	156 days,	
U_3,	Human,	24	Guinea-pig,	390 gm.,	210 gm.,	180 gm. loss,	Jan. 14,	Feb. 20,	....	37 days,	
U_3,	Human,	24	Guinea-pig,	360 gm.,	290 gm.,	70 gm. loss,	Jan. 14,	Feb. 21,	....	38 days,	43 days.
U_3,	Human,	24	Guinea-pig,	330 gm.,	265 gm.,	65 gm. loss,	Jan. 14,	Mar. 9,	....	54 days,	
U_3,	Human,	24	Rabbit,	1,710 gm.,	2,040 gm.,	330 gm. gain,	Jan. 14,	....	June 15,	152 days,	
U_3,	Human,	24	Rabbit,	1,490 gm.,	2,130 gm.,	610 gm. gain,	Jan. 14,	....	June 15,	152 days,	152 days.
W_3,	Human,	19	Guinea-pig,	745 gm.,	....	....	....	....	....	....	All animals
W_3,	Human,	19	Guinea-pig,	730 gm.,	....	....	....	....	....	....	living at
W_3,	Human,	19	Guinea-pig,	700 gm.,	....	....	....	....	....	....	end of 60
W_3,	Human,	19	Rabbit,	1,470 gm.,	....	....	....	....	....	....	days.
W_3,	Human,	19	Rabbit,	1,750 gm.,	....	....	....	....	....	....	
F_6,	Bovine,	23	Guinea-pig,	401 gm.,	220 gm.,	81 gm. loss,	Jan. 19,	Sept. 7,	....	56 days,	
F_6,	Bovine,	23	Guinea-pig,	480 gm.,	320 gm.,	160 gm. loss,	Jan. 19,	Aug. 16,	....	28 days,	39 1-3 days.
F_6,	Bovine,	23	Guinea-pig,	546 gm.,	340 gm.,	206 gm. loss,	Jan. 19,	Aug. 28,	....	40 days,	
F_6,	Bovine,	23	Rabbit,	2,350 gm.,	1,380 gm.,	970 gm. loss,	Jan. 19,	Nov. 23,	....	127 days,	
F_6,	Bovine,	23	Rabbit,	910 gm.,	670 gm.,	240 gm. loss,	Jan. 19,	Nov. 22,	....	126 days,	126½ days.
Q_4,	Bovine,	35	Guinea-pig,	380 gm.,	270 gm.,	110 gm. loss,	Jan. 19,	Aug. 4,	....	16 days,	
Q_4,	Bovine,	35	Guinea-pig,	510 gm.,	420 gm.,	90 gm. loss,	Jan. 19,	Aug. 12,	....	24 days,	24 2-3 days
Q_4,	Bovine,	35	Guinea-pig,	800 gm.,	560 gm.,	240 gm. loss,	Jan. 19,	Aug. 22,	....	34 days,	
Q_4,	Bovine,	35	Rabbit,	1,580 gm.,	980 gm.,	600 gm. loss,	Jan. 19,	Oct. 13,	....	86 days,	
Q_4,	Bovine,	35	Rabbit,	895 gm.,	875 gm.,	20 gm. loss,	Jan. 19,	Sept. 20,	....	73 days,	79½ days.

QQ_5, Bovine, ..	25	Guinea-pig, ...	560 gm., ..	380 gm., ..	180 gm. loss, ...	Aug. 4,	Aug. 22,	....	18 days, ..	24 days.
QQ_5, Bovine, ..	25	Guinea-pig, ...	510 gm., ..	370 gm., ..	140 gm. loss, ...	Aug. 4,	Sept. 3,	....	30 days, ..	
QQ_5, Bovine, ..	25	Rabbit, ...	1,930 gm., ..	1,500 gm., ..	430 gm. loss, ...	Aug. 4,	Oct. 17,	....	74 days, ..	
QQ_5, Bovine, ..	25	Rabbit, ...	1,340 gm., ..	1,080 gm., ..	260 gm. loss, ...	Aug. 4,	Aug. 11,	....	7 days, ..	
T_3, Bovine, ...	35	Guinea-pig, ...	390 gm., ..	290 gm., ..	100 gm. loss, ...	Sept. 11,	Oct. 21,	....	40 days, ..	36 1-3 days.
T_3, Bovine, ...	35	Guinea-pig, ...	420 gm., ..	265 gm., ..	155 gm. loss, ...	Sept. 11,	Oct. 10,	....	29 days, ..	
T_3, Bovine, ...	35	Guinea-pig, ...	455 gm., ..	340 gm., ..	115 gm. loss, ...	Sept. 11,	Oct. 21,	....	40 days, ..	
T_3, Bovine, ...	35	Rabbit, ...	1,210 gm., ..	1,090 gm., ..	120 gm. loss, ...	Sept. 11,	Oct. 18,	....	37 days, ..	49½ days.
T_3, Bovine, ...	35	Rabbit, ...	1,090 gm., ..	860 gm., ..	230 gm. loss, ...	Sept. 11,	Nov. 12,	....	62 days, ..	

TABLE V.

TABLE SHOWING RESULTS OF INOCULATION OF ANIMALS WITH TUBERCULOUS MATERIAL FROM BOVINE AND HUMAN SOURCES.

Material.	Reference number.	Animals.	Date of inoculation.	Method of inoculation.	Dose in c. c.	Initial weight.	Weight at death.	Loss or gain in weight.	Died.	Killed.	Length of life—days.	Average days.
Bovine, ...	9838	Horse, ...	July 14,	Intrapulmonary,	10	1,205 lbs.,..	1,010 lbs.,..	195 lbs., l., ..	Sept. 6, ...	....	54	60
Bovine, ...	9840	Horse,*	July 30,	Intrapulmonary,	10	1,075 lbs.,..	1,015 lbs.,..	60 lbs., l., ..	....	Nov. 14, '99,	66	
Bovine, ...	9701	Pig, ...	July 14,	Intrapulmonary,	4	130 lbs.,..	78 lbs.,..	52 lbs., l., ..	Aug. 23, ...	....	40	50¾
Bovine, ...	9702	Pig, ...	July 14,	Intrapulmonary,	4	131 lbs.,..	103 lbs.,..	28 lbs., l., ..	Oct. 19, ...	....	97	
Bovine, ...	9708	Pig,*	July 30,	Intrapulmonary,	5	94 lbs.,..	86 lbs.,..	8 lbs., l., ..	Sept. 12, ...	....	41	
Bovine, ...	9706	Pig,*	July 30,	Intrapulmonary,	5	85 lbs.,..	72 lbs.,..	13 lbs., l., ..	Aug. 21, ...	....	22	
Bovine, ...	9697	Sheep, ...	July 14,	Intrapulmonary,	5	66 lbs.,..	49 lbs.,..	17 lbs., l., ..	Aug. 27, ...	....	44	38
Bovine, ...	9696	Sheep,*	July 30,	Intrapulmonary,	5	71 lbs.,..	49 lbs.,..	22 lbs., l., ..	Aug. 31, ...	....	32	
Bovine, ...	9841	Dog, ...	July 15,	Intrapulmonary,	5	34½ lbs.,..	24 lbs.,..	10½ lbs. l., ..	Jan. 15, '99,	....	184	214½
Bovine, ...	8010	Dog,*	July 30,	Intrapulmonary,	5	28 lbs.,..	....	....	....	Mar. 20, '99,	245	
Bovine, ...	8089	Cat, ...	July 18,	Intrapulmonary,	2.5	2,508 gm.,..	1,695 gm.,..	813 gm. l., ..	Aug. 18, ...	....	31	25½
Bovine, ...	8091	Cat,*	July 30,	Intrapulmonary,	5	1,150 gm.,..	1,043 gm.,..	107 gm., l., ..	Aug. 19, ...	....	20	
Human, ...	8008	Horse, ...	Aug. 27,	Intrapulmonary,	10	1,205 lbs.,..	1,225 lbs.,..	20 lbs., g., .	....	Mar. 14, '99,	199	183½
Human, ...	8088	Horse, ...	Sept. 27,	Intrapulmonary,	10	1,200 lbs.,..	1,370 lbs.,..	170 lbs., g., .	....	Mar. 14, '99,	168	
Human, ...	9704	Pig, ...	Aug. 27,	Intrapulmonary,	5	80 lbs.,..	100 lbs.,..	20 lbs., g., .	Dec. 9, ...	....	104	58 1-3
Human, ...	9842	Pig, ...	Aug. 27,	Intrapulmonary,	5	91 lbs.,..	91 lbs.,..	....	Nov. 8, ...	....	73	
Human, ...	9844	Pig,†	Nov. 9,	Intrapulmonary,	5	70 lbs.,..	71 lbs.,..	1 lb., g., ..	Dec. 14, ...	....	35	
Human, ...	8095	Pig,‡	Dec. 14,	Intrapulmonary,	5	....	193 lbs.,..	....	....	Mar. 21, '99,	97	
Human, ...	9705	Pig,†	Nov. 9,	Intrapulmonary,	5	87 lbs.,..	107 lbs.,..	20 lbs., g., .	Dec. 7, ...	....	28	
Human, ...	8094	Pig,§	Dec. 7,	Intrapulmonary,	5	....	....	....	Dec. 20, ...	....	13	
Human, ...	9698	Sheep, ...	Aug. 27,	Intrapulmonary,	5	70 lbs.,..	74 lbs.,..	4 lbs., g., .	....	Mar. 17, '99,	202	202
Human, ...	9699	Sheep, ...	Aug. 27,	Intrapulmonary,	5	58 lbs.,..	79 lbs.,..	21 lbs., g., .	....	Mar. 17, '99,	202	
Human, ...	12179	Dog, ...	Sept. 8,	Intrapulmonary,	5	55 lbs.,..	28 lbs.,..	27 lbs., l., ..	....	Mar. 25, '99,	229	146
Human, ...	12180	Dog, ...	Aug. 27,	Intrapulmonary,	5	29 lbs.,..	32 lbs.,..	3 lbs., g., .	Oct. 29, ...	....	63	
Human, ...	10023	Cat, ...	Aug. 27,	Intrapulmonary,	2.5	2,190 gm.,..	....	....	Aug. 29, ...	....	......	......

Human, ...	10060	Cat, ...	Sept. 8,	Intrapulmonary,	5	....	....	....	Mar. 20, '99,	....	193	
Hum. Sputum,	5984	Calf, ...	July 29,	Intraperitoneally,	10	108 gm.,..	258 lbs.,..	150 lbs., g., .	....	Jan. 14, '99,	169	
Hum. Sputum,	8499	Calf, ...	July 29,	Intraperitoneally,	10	131 gm.,..	265 lbs.,..	134 lbs., g., .	....	Jan. 14, '99,	169	
Hum. Sputum,	8049	Calf, ...	May 16,	Intraperitoneally,	10	....	340 lbs.,..	....	....	Aug. 1, '98,	77	
Hum. Sputum,	8050	Calf, ...	May 16,	Intraperitoneally,	10	....	190 lbs.,..	....	....	Aug. 1, '98,	77	132½
Hum. Sputum,	8074	Calf, ...	Oct. 18,	Fed 11 times, ..	30-60	230 gm.,..	350 lbs.,..	161 lbs., g., .	....	Feb. 18, '99,	123	
Hum. Sputum,	8096	Calf, ...	Oct. 18,	Fed 11 times, ..	30-60	224 gm.,..	385 lbs.,..	120 lbs., g., .	....	Feb. 18, '99,	123	
Human, ...	9843	Calf,‖	Aug. 2,	Intraperitoneally,	20	108 gm.,..	....	....	....	Jan. 16, '99,	161	
Human, ...	9846	Calf,**	Aug. 2,	Intraperitoneally,	20	132 gm.,..	....	....	....	Jan. 10, '99,	161	

*These animals were inoculated with the tissues of guinea-pigs which had died of general tuberculosis due to inoculation with material from a tuberculous cow. This material was the same as that used for the inoculation of the other animals.

†Inoculated from tissues of pig 9842.

‡Inoculated from tissues of pig 9844.

§Inoculated from tissues of pig 9705.

‖Inoculated from tissues of calf 8049.

**Inoculated from tissues of calf 8050.

tuberculous organs of man and cattle, and that the two sets of animals would lend themselves to an interesting comparison, besides fulfilling the primary object of comparing the virulence of human and bovine material.

The plan was carried out for the bovine material, but failed for the human, as all the guinea-pigs died within forty-eight hours after inoculation. The second series of animals were inoculated with human material from another source and obtained at a later date. The results, while not entirely comparable, are nevertheless interesting and valuable.

Objections in Use of Tuberculous Material.—There are several disadvantages in using tuberculous material which were not overlooked in planning this work. (1) It is impossible to give accurate doses, for although our suspensions may be made of an equal opacity, and counts of equal amounts show approximately the same number of bacilli, there is no way of determining what proportion of these bacilli are capable of multiplication. (2) Material from man almost always contains other bacteria. Our knowledge of mixed infections is too scant to enable us to estimate the part played by those other species in determining the result; whether they inhibit or aid the action of the tubercle bacillus. The same is true of bovine material, although to a less extent, the tuberculous foci being more apt to remain inclosed. On the other hand, infection under natural conditions is always through such mixed material, and this method of inoculation approaches in some degree the conditions we meet in practice.

Source of Bovine Tuberculous Material.—The bovine tuberculous material was obtained from a cow six years old, which had shown symptoms of tuberculosis for a long time, and was finally condemned and killed. She showed, postmortem, a generalized involvement of the thoracic cavity with some invasion of the abdominal organs. In the lungs but little tissue approaching normal was found, and the pleurae were studded with small nodules. Many of the tuberculous areas in the lungs had undergone caseation. The mediastinal glands were enormously enlarged and caseous. Scattered over the peritoneum were many nodules. The liver was considerably involved, and the portal and mesenteric glands were enlarged and caseous. Other abdominal organs showed no macroscopic lesions. Nodules were taken from the pericardium, mediastinal and mesenteric glands, lung and pleura. After thorough trituration in a mortar, each part separately, they were mixed, sterile water added, and the whole strained through cheese-cloth. With this material a series of animals was inoculated, and at the same time a number of guinea-pigs. These all contracted tuberculosis, four dying on the fifteenth day. Portions of their organs were prepared in the same

way, and used for the inoculation of a second series of animals, as seen in Table V.

Sources of Human Tuberculous Material.—This material was obtained from three bodies, the lungs only being used. Two of the three were cases of well-marked acute miliary tuberculosis, the other a case of chronic phthisis, all adults. The material was prepared for injection in the same way as described for the bovine, the suspension being made as nearly of the same thickness as possible. The first series of animals was inoculated with the tissues from one of the cases of acute miliary tuberculosis on August 27. A number of guinea-pigs were also inoculated with the object of having their tissues for a second series of inoculations, as with the bovine material, but they all died of septicemia within forty-eight hours, preventing the execution of this plan. With the exception of the pigs, and the calves inoculated with sputum, the other animals were inoculated from the two cases mentioned above.

Method of Inoculation.—In all the animals the injection was made into the lung, the field of puncture being shaven, washed with soap and water, next with alcohol and ether, and lastly with a 1:1000 solution of bichlorid of mercury. The site of puncture was, for the horses, between the eighth and ninth ribs; for the pigs, sheep and dogs, between the sixth and seventh ribs; and for the cats, between the fifth and sixth ribs.

CONDENSED POSTMORTEM NOTES.

Horses. Bovine Material. Two Animals.—One died after fifty-four days, with loss of 195 pounds; the other was killed after sixty-six days, having lost sixty pounds. In both the desease was mainly in thoracic cavity. In the one inoculated with material direct from cow, both lungs were involved throughout. In the other the tuberculous process was confined to the lung into which injection was made, and marked only near site of inoculation.

Horses. Human Material. Two Animals.—Both had to be killed. One was entirely normal, not even the point of inoculation being discernible. In the other the tuberculous process was confined to an area 5 cm. in diameter, with the point of inoculation as a centre.

Pigs. Bovine Material. Four Animals.—All died with an average length of life of fifty and three-quarter days. The two which received the bovine material direct lived sixty-eight and one-half days, as against thirty-three days for those inoculated from the guinea-pigs. In all, the lungs were the chief seat of the disease, all showing an acute miliary tuberculosis of both organs. In the two inoculated directly from the cow, the abdominal cavity was invaded to a limited extent, seen only in the mesenteric glands.

Pigs. Human Material. Six Animals.—Five died and one was killed. The average length of life of the two inoculated directly

from man was eighty-eight and one half days; for the three inoculated with tissues of other pigs which died, the average was twenty-two days. In the two first the lungs were invaded throughout with miliary tubercles, and one showed areas of pneumonic character. In neither was the abdominal cavity involved. Of the four pigs inoculated with material from the other pigs which had succumbed to inoculation with human tissues, three presented a diffuse tubercular pneumonia, rapidly fatal, one living only thirteen days. The remaining animal was normal with the exception of the right lung and pleura. Both visceral and parietal pleurae were largely covered with nodules 2 mm. to 12 mm. in diameter, many of them caseous. The lung was dense throughout, and contained many caseous areas, most marked near the surface.

Sheep. Bovine Material. Two Animals.—Both died, the one inoculated directly with bovine material in forty-four days, the other in thirty-two days. Both were considerably emaciated, and in both the disease was confined almost entirely to the thoracic cavity, the spleen being the only abdominal organ involved, and this only slightly so. In both the lungs showed hepatization, more marked in the one inoculated with the tissues of the guinea-pig.

Sheep. Human Material. Two Animals.—Both were killed 202 days after inoculation. One was entirely normal, with the exception of an area in the right lung 5 cm. in diameter at the point of inoculation, in the centre of which was a caseous abscess, the pus containing many tubercle bacilli. The second animal was normal throughout.

Dogs. Bovine Material. Two Animals.—The dog which received the bovine material direct became markedly ill, much emaciated, and died after 148 days. The pleural surfaces of both lungs were covered with minute nodules, and were almost completely consolidated. In right lung at point of inoculation, was a small abscess, 25 mm. in diameter.

The dog inoculated with tissues of guinea-pig showed little effect from it, and was killed after 215 days. The only lesion found was an abscess cavity 12 mm. in diameter at point of inoculation in right lung, scrapings from the wall of which contained many tubercle bacilli.

Dogs. Human Material. Two Animals.—One killed after 229 days. The only evidence of disease was the presence of numerous minute nodules on the pleural surfaces of both lungs, and a few on the pericardium. The lungs were normal otherwise.

The second dog began to cough after six weeks, lost flesh rapidly and died on the sixty-third day. Both pleurae contained six ounces of sanguinolent pus. The lungs were the seat of an extensive miliary tuberculosis, and at point of inoculation in right lung was an ab-

scess cavity 7 c. m. long by 2. 5 mm. in diameter. The abdominal organs were not involved.

Cats. Bovine Material. Two Animals.—Both became rapidly ill, one dying in twenty and the other in thirty-one days. In both the lungs were the seat of an acute miliary tuberculosis. In the one which received the bovine material direct, the spleen contained a number of cheesy areas. In the other the mesenteric glands were enlarged and cheesy. The more rapid progress of the disease in the latter was probably due to its smaller size and the larger dose.

Cats. Human Material. Two Animals.—One cat died after two days and has not therefore been included in the averages. The second was killed after 193 days and found to be normal throughout. Not even the point of inoculation could be determined.

Summary.—Twelve animals were inoculated with bovine material. Ten of these died, while two survived—the horse and the dog which received the tissues of the guinea-pig.

Fourteen animals were inoculated with the human material, of which eight died and six were killed.

For most of the animals the tuberculous material direct from the cow seemed to be the more virulent. The sheep and pigs were exceptions to this, the pigs notably so, those receiving the tissues of guinea-pigs dying in thirty-three days, as against sixty-eight and one-half days for the others. The averages of life after inoculation given in the table, as well as the greater mortality, show strikingly the increased potency of the bovine material over that from man.

This difference is further brought out by the extent and character of the lesions produced by the one and the other, as shown in the postmortem notes, and in Table VI.

Infection of Calves with Human Tuberculous Sputum.—The results of this experiment are included in Table V, the details which are of considerable interest being supplied here.

Calf 5984, age five weeks, weight 108 pounds, was inoculated intraperitoneally with 10 c. c. of sputum from an advanced case of tuberculosis at the University Hospital, on July 29, 1898. The patient from whom the sputum was obtained was a young adult who had been sick about a year and a half, and had been expectorating freely for one year. A cavity had been observed in the left lung about eight months before the sputum was obtained. Death occurred soon after. Beyond some slight elevation of temperature this calf showed no effect whatever from the inoculation. On November 3, 1898, it was tested with tuberculin, but gave no reaction. When it was killed on January 14, 1899, it weighed 258 pounds, an increase of 150 pounds. It was in good condition and showed no tuberculous lesions in any part of the body. The site of inoculation could not be determined.

TABLE VI.

TABLE SHOWING COMPARATIVE EXTENT OF LESIONS PRODUCED BY INOCULATION OF HUMAN AND BOVINE MATERIAL.

	Bovine Material Direct.	Bovine Material Passed though Guinea-Pigs.	Human Material Direct.	Human Material Passed through other Animals.
Horses, ...	Extensive disease of thoracic cavity.	Extensive involvement of lungs.	One horse limited involvement of one lung. The other was normal throughout.	
Pigs, ...	Extensive disease of thoracic cavity.	Extensive disease of thoracic cavity.	Extensive disease of thoracic cavity.	Rapidly fatal, very acute process confined mainly to lungs. Slower process in one, confined to lung and pleura of one side.
Sheep, ...	Extensive disease of thoracic cavity.	Extensive disease of thoracic cavity.	Limited involvement of one lung and pleura of same side in one animal. The other normal throughout.	
Dogs, ...	Extensive disease of thoracic cavity.	Limited involvement of one lung.	Limited involvement of pleura and pericardium in one animal. In the other, extensive disease of thoracic cavity.	
Cats, ...	Extensive disease of thoracic cavity and spleen.	Extensive disease of thoracic cavity and mesenteric glands.	Normal throughout.	

Calf 8499, age five weeks, weight 131 pounds, was inoculated on July 29, 1898, with 10 c. c. of sputum of a patient at the University Hospital. This patient was adult male; a miner by occupation. He had been under treatment for nine months. At this period the apices of both lungs were consolidated. He had a cough for two years, lost flesh, and had one severe hemorrhage. He expectorated a large abount of mucopurulent sputum. This calf showed an elevation of temperature which continued almost without intermission for three months, reaching as high as 105.8 degrees Fahrenheit in August and September. On November 3, 1898, it was tested with tuberculin and gave a reaction. It was killed on January 9, 1899, weighing 265 pounds, an increase in weight of 134 pounds. It was in fair condition. There was a nodule in the peritoneum at the site of inoculation. In the omentum were numerous calcareous nodules the size of a hazel-nut, and one softened nodule the size of a hen's egg, which contained an inspissated purulent material, and five smaller ones of the same character. The lungs, liver and spleen were normal, but on the pleural surface of the diaphragm there was a deposit of fibrin which contained several well defined nodules. On the abdominal surface of the diaphragm was a small amount of grape formation.

Calf 8049, age about four weeks, was inoculated on May 16, 1898, intraperitoneally with 10 c. c. of sputum from an advanced case of pulmonary tuberculosis at the University Hospital. The sputum contained many bacilli. Beyond a slight cough, which was noticed in July, it showed no symptoms of discomfort and grew rapidly. It was tested with tuberculin on July 30, and gave good reaction. It was killed on August 1, weight 340 pounds, condition good; large amount of fat. On the surface of both lungs and on the pleural surface of the diaphragm was a fibrinous deposit. In the cervical lobe of the right lung a few small nodules were found on section. The mediastinal and bronchial glands were somewhat enlarged. The omentum contained a few nodules, and one, about one inch in diameter, which had undergone softening, the contents being rich in tubercle bacilli. The spleen showed a number of nodules. About one-half of the mesenteric glands were enlarged and showed cheesy degeneration. An emulsion from the centre of the softened nodule in the omentum and from portions of the spleen were made and 20 c. c. injected intraperitoneally into calf 9843, four weeks old, weight 108 pounds, on August 2. Beyond a slight cough, noticed on October 10, the animal showed no ill effects from inoculation. It was killed on January 10, 1899, condition good. The omentum was adherent to the peritoneum at the point of inoculation and contained some ten nodules about the size of a pea. In every other respect the animal was entirely normal.

Calf 8050, age four weeks, was inoculated on May 16, 1898, with

sputum from an early case of pulmonary tuberculosis at the University Hospital. The sputum contained a large number of tubercle bacilli. Soon after inoculation the temperature of the calf rose and continued high, with some remissions, until it was killed. Its appearance was bad, the coat dry and rough, the respiration rapid. It was tested with tuberculin, but the temperature was too high for results. It was killed on August 1, weighing 190 pounds. On the surface of both lungs there was a slight deposit of fibrin, and on section a number of hemorrhagic areas were observed in both. The mediastinal and bronchial glands were enlarged and congested. The abdominal cavity contained about twelve ounces of bloody serum. The peritoneum was thickly studded over its entire surface with nodules from 1 mm. to 12 mm. in dimeter, fibrous in character. In many places these nodules had massed together, forming tumors, some 5 cm. in diameter, which were dense and fibrous. The spleen contained many nodules, both on the surface and throughout its substance. The whole omentum was thickly studded with nodules from 2 mm. to 12 mm. in diameter, and besides which there were three large masses, dense and fibrous in character, two of which were 15 cm. long by 7 cm. wide, and 12 mm. thick; and the third 7 cm. long. by 6 cm. wide, by 4 cm. thick. The abdominal surface of the diaphragm was thickly studded with nodules, fibrous in character. The mesentery was thickened and contained many nodules of small size. The appearance was that of a typical case of grape or pearl disease. The mesenteric and mediastinal glands were enlarged and somewhat caseous. Twenty c. c. of an emulsion made from these glands, which contained a large number of tubercle bacilli, were injected on August 2 into the peritoneal cavity of calf 9816, four weeks old, weight 132 pounds. The animal showed no ill effects whatever from inoculation and was killed on January 10, 1899. A careful postmortem examination showed it to be normal in all respects.

Summary.—Four calves of nearly the same age received intraperitoneally 10 c. c. of human tuberculous sputum from different sources, but in all cases containing a large number of tubercle bacilli.

One showed no ill effect from the injection exccept a slight rise of temperature, and when killed the autopsy was entirely negative.

Of the other three, two had persistent high temperature following the injection, but only one showed marked illness otherwise. Postmortem examination proved that all had become infected with tuberculosis, the lesions in two being quite extensive. From each of these two a second calf was inoculated intraperitoneally with an emulsion made from well-developed nodules. In both cases the emulsion was rich in tubercle bacilli, and a large dose (20 c. c.) was injected. The result was absolutely negative in one animal and practically so in the other.

Since both calves received a much larger number of tubercle

bacilli in the emulsion than those injected with the sputum, we are led to conclude that the result in the latter was due to a mixed infection which operated to the advantage of the tubercle bacillus.

The attempt to infect calves with human sputum by the digestive tract failed wholly. Two young calves (Table V, Nos. 8071 and 8096) were given from 30 to 60 c.c. of sputum containing many tubercle bacilli on eleven days. Some disturbance of digestion resulted at the time, but when killed no trace of tuberculosis was detected.*

Indications for Further Investigation.—In the further elucidation of this question, cultures should be isolated from as many cases of primary intestinal tuberculosis, and especially those cases in which there is reason to suspect infection by meat or milk. Having obtained the cultures, it may well be asked whether or not we are in a position to determine positively the origin of the offending organisms. Are the differences which have been noted in culture, morphology and virulence, sufficiently marked and persistent to make differentiation possible? This I doubt. In my judgment much more work must be done before we shall be able to determine the origin of a given culture of the tubercle bacillus by examination of it in cultures. At present we know practically nothing of the influence of the human body on the tubercle bacillus, nor what changes may be induced in its morphology, cultural peculiarities and virulence by residence in the human tissues, nor what length of time is necessary to induce such changes, if induced at all. In my studies I have, as shown in Table III, recovered the tubercle bacillus, both human and bovine from horses, dogs, swine, goats, and in one instance had the rare if not unique opportunity of recovering the bovine organism from man after accidental inoculation. These recovered cultures have all been carefully compared with the originals, and while some differences have been observed, and noted in the remarks following the table, with possibly one exception, they have not been of a marked or distinguishing character. In the case of the man the bacillus remained in his tissues from January 1 to February 27, fifty-eight days. The recovered culture was practically identical with the original. This is, however, a shorter time by a great deal than elapses between intestinal infection in children through food and their death, and does not enable us to draw conclusions as to these cases. Like the culture recovered from animals, it indicates that the tubercle bacillus is quite tenacious of its characteristics, as a rule. We have noted constantly that the bacilli found in scrapings from the various organs of the animals inoculated with bovine cultures have been long and beaded though the culture used was of the short and unbeaded type. The recovered cultures, however, on blood-serum have always resembled the original. In

*This experiment was conducted by Dr. W. G. Shaw, to whom all the credit is due.

a series of examinations of material coughed up by cows, I failed always to find bacilli of what has been described as the bovine type. In fact, the longest tubercle bacilli I have ever observed, except in old cultures, were seen in some specimens of this material. The virulence of this material was greater considerably than human sputum ordinarily is, though the comparison was not made with accuracy.

Retention of Characteristics in Culture.—On blood-serum with 5 per cent. of glycerin, the tubercle bacillus from bovine sources, will, as a rule, retain its morphological and cultural characteristics for a long time. Culture H has now grown for two years (July 6, 1901), and is of the sixteenth generation. Beyond an increased vegetation, no marked change can be detected in it. With a single exception (Culture F) the same may be said of all the cultures isolated. This culture was isolated with some difficulty, and so scant was the growth for six generations that I was several times on the point of abandoning it. Only in the sixth generation was growth enough obtained for experimental inoculation. Considerably more growth took place in the seventh, and the eighth grew luxuriantly, since which all sub-cultures have been abundant. From the eighth generation on serum cultures were made on 5 per cent. glycerin agar, and an abundant growth obtained on this medium in the first transfer.

Co-incident with this increase of vegetative power came a marked change in the morphology. From being short, thick and staining evenly, it is now long, more slender than in the early growths and shows marked beading. In other words, from being a typical "bovine" culture, it has during the past ten months so changed that it can now pass as a typical "human" culture. It will be observed, by reference to Table IV, that its pathogenic power for guinea-pigs and rabbits was not as great as is usually found in bovine cultures.

Culture in Collodion Sacs.—The method of culture in the body of living animals, which has been productive of such brilliant results in the hands of the French, offers much assistance in the solution of the problem before us. It has enabled Nocard[4] to demonstrate the possibility of so modifying the mammalian tubercle bacillus that it becomes like the avian organism in culture and pathogenicity. We are now attempting to modify, two feebly virulent human cultures by residence in the peritoneal cavity of cattle.

Culture M was kept for seven months in the abdominal cavity of a heifer, inclosed in collodion sacs, two sacs being used. On removing the sacs but little multiplication of the bacilli was noted. Cultures were recovered directly from the sacs. In the first transfer the cultures grew more rapidly and abundantly than the original culture, but the morphology of the individual bacilli cannot be said to have changed to a noticeable degree. The virulence was not in-

creased. Rabbits were not killed by sub-cutaneous inoculation. Guinea-pigs died after an average of forty-two and one-third days. A calf inoculated intraperitoneally showed no ill effect and gave no reaction to tuberculin after seven weeks.

Culture Nasua Narica (Coati) of Theobald Smith, inclosed in collodion sacs, was kept in the peritoneal cavity of a yearling heifer for eleven months. On removal there was considerable increase in the growth, especially in one sac. Cultures were recovered from the sacs, and showed some marked changes, especially in manner of growth. On both blood-serum and glycerin agar, the growth was most rapid, at least twice as rapid as usual for this culture. On serum it covered the surface in seven to ten days, as a thick, white, moist layer, almost cottony near the water at bottom. On glycerin agar the growth was more dry and wrinkled, but very rapid. The bacilli stain more evenly, and are on the whole shorter, though long forms are seen. Guinea-pigs and rabbits inoculated subcutaneously are still alive after four months. A calf which received 4 c. c. of a milky suspension in the jugular vein reacted to tuberculin after ten weeks.

The experiment is being continued, the culture recovered from the capsule having been placed again in the peritoneal cavity of another calf.

No conclusions can be drawn as yet, though the indications are that both cultures have become less strictly parasitic rather than more so, by the procedure.

Interpretation of Results.—Accepting it as proven that the bovine tubercle bacillus has, as a rule, considerably greater pathogenic power than the human bacillus for a large majority of experimental animals, how should we interpret this in regard to man? Is it fair to conclude that this increase of virulence will hold good for man also? Until the contrary is proven, or until good reason for believing the contrary is shown, it is in my judgment right that this conclusion be held, at least as a working hypothesis. I am aware of the objections to this view that will be raised by some, and acknowledge freely that it cannot be accepted as conclusive. Virulence is, no doubt, a factor which is relative to the subject, and exaltation of virulence for one species does not necessarily prove an increased virulence for other species. Indeed, the reverse is true in some instances.* However, it cannot be denied, as a general rule, that when the virulence of a pathogenic organism is increased for one animal it is increased for all that are naturally susceptible to its action.

The tubercle bacillus is unique in the extent of its pathogenic activity, both by direct experimental inoculation as well as by infec-

*The streptococcus is said to become increased in virulence for mice by successive passages through these animals, but less virulent for rabbits.

tion under what may be considered more or less natural conditions. The list of animals in which tuberculosis has been observed in parks and zoological gardens is appalling, the discoveries of Dubard[5] and others showing that not even the cold blooded animals are exempt from this universal scourge. While it may be said of the tubercle bacillus that in cultures in the laboratory it is unusually tenacious of its characteristics, it is certain that in nature it has a wide range of adaptability as a pathogenic agent. Hence for the tubercle bacillus, perhaps more than for any other known microbe, we are justified in believing that an exaltation of virulence for practically all experimental animals will hold good in the case of man also.

The question can be determined definitely only by direct inoculation of man. To do this experimentally is of course impossible, consequently we are forced to rely for evidence of this nature on those accidental cases which occur from time to time. It has been my fortune to have three such cases come under my observation, in each of which the infecting organism was known positively to be of bovine origin.[6] Similar cases have been reported by Tscherning[7] and Pfeiffer,[8] the latter ending in general infection and death. To these may be added two cases observed by Dr. M. B. Hartzell,[9] of the University of Pennsylvania, though in both, absolute proof of the bovine origin of the offending organism is lacking. Both occurred in healthy men employed by one of our large American railways to clean and repair cars used in the transportation of cattle. In both a well developed tuberculosis of the skin followed slight wounds of the back of the hand inflicted by broken timbers. In one case the local disease was soon cured and no further trouble resulted. The other, however, ended fatally after about a year, through the infection becoming generalized, with involvement of the lungs. This patient was a robust man, forty-four years old, weighing 175 pounds, with good family and personal histories. Dr. Hartzell felt able to exclude with reasonable certainty any other source of infection.

Cases such as these permit us to deny with authority the claim which has been made by certain persons that by long residence in animals of the bovine species the tubercle bacillus becomes so changed as to render it incapable of successful residence in the tissues of man. In all of these instances the bovine bacillus grew and multiplied under conditions known to be most unfavorable to it, with the production of characteristic lesions, and in two of the seven cases gained access to the internal organs, causing death, a result which is unusual when the local lesion is due to infection from human sources. While the number of cases is too small to enable us to draw sweeping conclusions, the indications are that by this mode of inoculation the pathogenic power of the bovine bacillus is at least as great as that possessed by its human congener.

Infection through Food.—It will not be necessary here to review

at length the reported instances of infection through the digestive tract following the use of food products from tuberculous cattle. Most of these of necessity lack precision, and are not absolutely demonstrative, though seme of them have, as Nocard has said, "almost the value of an experiment."

The well-known observations of Stang,[10] Demme,[10] Gosse[10] and Ollivier[11] leave little doubt of the power of the bovine tubercle bacillus to infect man through the digestive tract.

Statistical Evidence.—The evidence derived from the statistics of tuberculosis on this point is purely circumstantial, yet of such strength as to be most convincing. The compilations of Dr. Tatham bring out most strikingly the fact that in early life some potent factor is at work in causing tuberculosis. In the Harben Lectures for 1898, Sir Richard Thorne speaks of this as follows: "So also, if you will compare the rates in Tables A B and C and contrast the reduction of 27.9 per cent. which has taken place, under five years of age, during the last forty-five years in all forms of tubercular disease, and that of 66 per cent. in phthisis, with the corresponding one from tabes mesenterica, which only reached 3.0 per cent. you will see that in considering the latter cause of death we are dealing with a totally different state of affairs.

"The matter, too, assumes a still more serious aspect if we limit ourselves to the first year of life, when milk is most largely used as food; for then we find that the reductions in the rate of death from the various forms of tuberculosis, which reduction has been going on at 'all ages' for about half a century, not only disappears, but is actually transformed into a large increase, reaching no less than 27.7 per cent. This in itself is grave enough, but its significance is still further emphasized when we remember what are the circumstances under which this increase in the rate of death from tabes mesenterica has gone on synchronously with a decrease in that from other forms of tuberculosis."

Evidence of a similar nature is given by Dr. Still,[12] of the Great Ormond Street Hospital for Children, in his analysis of 769 consecutive autopsies of children under twelve years of age, 269 of which showed tuberculous lesions. Of these, 117, or 43.5 per cent. were in children under two years old, while in the first three years of life 56.5 per cent. or more than a half of the total number, occurred. From his study of the lesions in these cases Dr. Still believes that in 153, or 56.8 per cent. the respiratory tract was the channel of infection, while in 63, or 23.4 per cent. the alimentary canal was responsible, the remaining fifty-three cases being uncertain or were otherwise accounted for. Accepting these figures as given, they indicate strongly that milk, the most largely used food, has a considerable part in the spread of tuberculosis, and justify the conclusion quoted from a report made to the council of the British Medical

Association, that "the mortality from tuberculosis in early childhood is not decreasing as it is at other ages in the United Kingdom, and the opinion that this great prevalence of the disease in childhood is due to infection through the alimentary canal by milk from tuberculous cows appears to be well founded."

From Germany comes further confirmatory facts. Widerhofer gives an analysis of 118 cases of tuberculosis in children, showing among them 101 with involvement of the intestine. Of these 43, or 42.5 per cent. were between the ages of two and five years, the period of life when cows' milk forms a large part of the food for children.

Conclusions.—In view of the foregoing experiments, and of the evidence quoted, it seems justifiable to conclude—

1. That the tubercle bacillus from bovine sources has in culture fairly constant and persistent peculiarities of growth and morphology, by which it may tentatively be differentiated from that ordinarily found in man.

2. That cultures from the two sources differ markedly in pathogenic power, affording further means of differentiation, the bovine bacillus being very much more active than the human for all species of experimental animals tested, with the possible exception of swine, which are highly susceptible to both.

3. That tuberculous material from cattle and from man corresponds closely in comparative pathogenic power to pure cultures of the tubercle bacillus from the two sources, for all animals tested.

4. That it is a fair assumption from the evidence at hand, and in the absence of evidence to the contrary, that the bovine tubercle bacillus has a high degree of pathogenic power for man also, which is especially manifest in the early years of life.

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REPORT OF PROF. R. C. SCHEIDT, ENTOMOLOGIST TO THE STATE BOARD OF AGRICULTURE.

Harrisburg, Pa., January 23, 1901.

The chief injurious insects which came to my notice during the year 1900 were, the Cecropia Emperor Moth (Platysamia cecropia), the Peach Lecanium (Lecanium nigrofaciatum) the Forest Tent Caterpillar (Clisicampa disstria), the Oyster-Shell Bark-louse (Mytilaspis pomorum), the Peach Twig Borer (Buarscalineatella) and the San José Scale (Aspidiotus perniciosus).

The Emporer Moth was reported to be prevalent in the neighborhood of Milton, Northumberland county. I received a number of the characteristically large grayish-brown cocoons attached to twigs of the apple tree, with the request to give their name and suggest a remedy. I at once complied with the request and had a full description of the life history of the insect, together with that of the approved remedies inserted in the Milton daily paper. The Emperor Moth is one of the largest and most beautiful of American insects, measuring often six or seven inches across the front wings. The wings are of a mottled dark brown color with clay colored hind margins; they are characterized by an opaque kidney-shaped dull red spot, white in the center and black along the edges, parallel to the outer margins of the wing a wavy reddish band with internal white border is situated. The fore-wings are marked near the shoulders by a curved white band upon a dull red background, while an eye shaped black spot within a bluish white crescent ornaments the tips. Body and legs are reddish and white on upper and under surface. The eggs are deposited in the month of June on a great variety of fruit and shade trees, hatching about a week later into small, spiny caterpillars, which devestate the foliage with great rapidity, growing constantly until they reach at maturity, late in summer, a length of three inches and more and a thickness of almost three-fourths of an inch; along the back they bear rows of large, coralled tubercles. In autumn the large silken cocoons of great density and toughness are spun and the caterpillars change within into dark brown pupae, which remain domant all winter. It is however only after mild winters that the caterpillars become dangerously injurious; their parasites are so numerous that the number is greatly reduced. A careful watching of the trees and prompt removal by hand-picking or, if necessary, by spraying with arsenites easily prevent the spread of this insect.

The Peach Lecanium (Lecanium nigrofascinatum), seems to have been prevalent throughout the State of Pennsylvania, but from all accounts in considerably smaller numbers than during the previous year. It is perhaps not generally known that our species is not identical with the European Lecanium (Lecanium persical) under which name we still find it described; Mr. J. W. Douglas, the celebrated Coccidologist of London, England, pronounced it in 1895 an undescribed species.

The adult female is most generally observed, being attached in large numbers on the under side of the twigs about the buds. They are from 3 to 4 mm. long, 2.6 mm. in diameter and about 2 mm. high, somewhat hemispherical, broadest posteriorly and of glossy appearance due to a transparent, waxy excretion. Its external surface shows a more or less smooth disk with about 12 radiating ridges on each side. In color they are either entirely red or black, or red with black bands. They have a pair of six-jointed autenuae and their legs are rather long and slender and covered with hair and bristles. About the middle of June they begin to hatch continuing till the middle of July. The sexes of the larvae, which are pale yellow in color, are undistinguishable; but after one week's pupal period the males have developed wings, beautiful and iridescent, but their glory only lasts about one week while the females continue attaching themselves to the bark of trees, doing their destructive work of sucking the sap from beneath the bark and thereby killing the tree.

The Peach Lecanium is comparatively harmless as long as the trees are carefully watched; the scales can be easily scraped off from the lower branches, while two or three applications of kerosene emulsion will thoroughly destroy this little pest in all parts of the tree.

The Forest Tent Caterpillar (Clisiocampa disstria), made its appearance in Lancaster city and county and became very destructive, especially to poplar and maple trees throughout the whole summer season. The streets with whole rows of skeletonized trees looked very unsightly and it required heroic measures to check the universal spread of this insect. The Apple Tree Tent Caterpillar (Clisiocampa Americana), has been known for years, but its damage has never reached the dimensions as that of the forest tent caterpillar which made its inroads into New England about six years ago. Late in May and early in June compact silken nests or tents appear in all kinds of deciduous trees, but especially in elm, poplar and maple, containing a large number of beautiful caterpillars of various sizes. They feed on leaves on all parts of the tree, but evidently prefer the upper and outer branches, eating the parenchyana of the blade along either side of the midrib, or in thick leaves along both sides of the veins. The nest or tent is usually made at the end of the branch, frequently the last leaf is utilized, in which they continue to live for

six weeks. They leave for their meals at regular times and return in processions. When fully mature they measure two inches, are covered with hairs and very varigated in color, yellow and blue lines predominating along the sides, while the lower surface is black and the middle of the back ornamented with a white band. Pupation takes place in some hidden spot in the cracks of the wall or under boards where the yellow silken cocoon is spun. In two or three weeks the reddish-brown moths come forth, pair and deposit clusters of eggs along the twigs of the trees covering them with a viscid varnish-like liquid to protect them against the cold of the winter.

During very wet weather the caterpillars are destroyed in large numbers by bacteria; there are also a number of primary, secondary and tertiary parasites which decrease the number of these voracious caterpillars considerably. I found the most effective remedy in the careful watching of the ends of the branches and the immediate removal of cutting or smoking, but the spraying with Paris Green or kerosene emulsion never fails, if repeatedly applied.

The Oyster-Shell Bark-louse (Mytilaspis pomorum), appeared in large numbers on shade trees, apparently killing many of them, but a liberal use of whale oil soap mixed with coal oil completely destroyed the pest and all the trees under my observation assumed their accustomed vigorous growth.

Unfortunately, the Peach Twig Borer (Anarsia lineatella) has also made its appearance among us. I first observed the larvae of this moth in the beginning of April on the new leaf shoots. They are of a yellowish-brown color and about 2 mm. long. They had eaten into the shoot as far as the pitch and in some cases burrows, varying in length from one-fourth to one and one-half inch, were found near the petiole. I noticed them again in the fall, hidden in burrows of the bark near the crotches of the branches of the peach; in this condition they seem to hibernate. Some of the adult larvae reach a length of a half an inch and become reddish in color; it spins a very loose cocoon in the leaves of the tree and turns into a good sized chrysalis, from which it emerges in a week or ten days a full fledged moth of beautiful dark gray color with dark spots on the forewings. Its width is about half an inch. Since but comparatively little is known about this insect, it is rather difficult to detect it and yet they may do considerable damage. I found quite a large number of peach fruit ruined, the peaches having been bored into a little way near the stem.

The best method of preventing the injuries of this insect is to look carefully for the comparatively large size of the egg and its striking irridescent appearance, generally found at the base of the petiole, and to clear the tree by scraping or by a thorough soaking of the bark with a solution of Paris Green.

The most aggravating insect of the year was the San José

Scale (Aspidiotus perniciosus). Lancaster city and county are thoroughly infected with this pest. I have tried my best to call the fruit growers' attention to this fact and a great many have done their utmost to clean their orchards. Hundreds of trees were burned in places where the bark was covered fully one-eighth of an inch with the scale. In other cases whale oil soap and kerosene was freely used and I believe with adsolutely perfect success. In the nurseries I have always advised the burning of the trees and the great majority of nurserymen are anxious to clean their premises; many of them never sell a tree unless it has been fumigated with hydrocyanic gas and dipped in whale oil soap. In my certificates to nurserymen, on whose premises I found the scale, I always stated that I would see to it that no tree should leave that nursery which had not been carefully examined and the parties themselves signed a pledge obligating themselves to thoroughly clean all their stock before selling it. I have, however, discovered that these promises have not always been carried out and I shall therefore refuse further certificates in all such cases. I have, however, also discovered that the San José Scale is rather on the decrease than on the increase, due largely to a parasite, *Aphelinus fascipennis*, which seems to propagate as fast as the host upon which it feeds. Prof. W. G. Johnson, of the Maryland station, has therefore advised fruit growers not to burn infested twigs and branches, but to dig up the tree by the roots, trim it and pile the brush and wood in the orchard, where they should be left until about the 1st of June or longer; in case spraying would be a sufficient check, the pruning should be done first and the cut off twigs and branches placed where the spray cannot reach them. This will insure the safety of the parasites.

Nevertheless, I cannot refrain from calling the attention of the State authorities to the fact that a much more stringent supervision should be exercised than has hitherto been the case. If we as merely honorary entomologists refuse to grant certificates, these will be obtained from the next best squire and the people will be entirely without protection.

REPORT OF HENRY SKINNER, M. D., ENTOMOLOGIST, TO THE STATE BOARD OF AGRICULTURE.

INSECTS AS FACTORS IN THE TRANSMISSION OF DISEASE.

Harrisburg, Pa., January 23, 1901.

Probably the most important subject at the present time is the question of the distribution of disease by the agency of insects. This is of vital importance, not only to scientists and medical men who are laboring in the cause of humanity, but also to the agriculturist and horticulturist, as these classes have many interests affected thereby. These researches into the causation and transmission of disease and a knowledge thereof will aid the farmer in preventing many maladies of his domestic animals, of his crops, and also among the members of his own household. These subjects also appeal to the farmer from a pecuniary standpoint, as the prevention of sickness and disease among domestic animals and in plants means a great saving in money value, and if he can prevent disease and the risk of death so far as he himself is concerned as well as among those near and dear to him, it is not only a saving of time and money but a prevention of sorrows that otherwise may be most distressing.

Attention has been drawn to these important studies by the mortality from disease among our troops during the late Spanish-American War, but the subject is not a new one. As far back as 1871, Dr. Joseph Leidy, of the Academy of Natural Sciences of Philadelphia, stated emphatically that in his opinion the common house-fly was responsible for the spread of hospital gangrene during our Civil War. In 1882 Dr. A. F. A. King expressed his belief that mosquitoes were the agency by which malaria is conveyed to human beings. In 1881, Dr. Ch. Finlay published a paper in which he took the ground that the mosquito was the agent of transmission of that dread disease of the tropics, yellow fever. Other observers abroad, notably Dr. Patrick Manson in China, have shown that certain tropical diseases are distributed by mosquitoes.

The growth of knowledge of the life history of the lower forms of life has been slow and interesting and a brief reference to it may prove instructive. Anaximander, of Miletus, Greece (610 B. C.) held that animals were formed from moisture, and Aristotle (384 B. C.) taught that every dry substance that becomes moist and every moist

body that becomes dry, produces living creatures. He also asserted that animals are formed in putrefying soil. A true conception of the wonderful changes of form which insects undergo was unknown before the year 1618. Prior to that time insects were supposed to have been spontaneously generated. Eels were supposed to be generated from the slime of the Nile and maggots were thought to be spontaneously generated in meat. Dr. Francesco Redi, physician to the Grand Dukes Ferdinand the Second and Cosmos the Third of Tuscany, made an interesting series of experiments and proved that maggots never develop in meat if flies are prevented from laying their eggs on it. He showed that the maggots were the young of the flies and that the maggots hatched from eggs laid by the flies, and destroyed the belief in spontaneous generation for all time. The wonderful changes in form in insects is well illustrated by the butterfly, the female of which lays a minute egg on a plant; the egg hatches and produces a little caterpillar which feeds on the plant until full grown; it then changes into an immovable apparently dead object, termed a chrysalis. In due time a butterfly emerges from the chrysalis and the same process is repeated through the seasons indefinitely. It is necessary to understand these life histories to get a rational idea of insect life in relation to economic entomology.

Before we can understand the transmission of disease by insects it is necessary to know something of the new science known as bacteriology, and popularly known as the germ theory of disease. It is, however, no longer a theory but a demonstrated scientific truth. In 1862 the celebrated French scientist, Pasteur, proved that many floating particles in the air were living, organized bodies. These are popularly called germs. Pasteur also proved that animal solids did not putrefy or decompose if kept free from access of germs. In 1873, Obermeier observed minute, actively moving, flexible, spiral organisms in the blood of patients suffering from relapsing fever. These discoveries were followed by equally important ones, demonstrating the cause of consumption, cholera, plague and other diseases. Thus many diseases are caused by minute living organisms, which are in some cases vegetable and some animal. The vegetable organisms are called bacteria and are minute plants. They can only be seen under the higher powers of the microscope. The unit of measurement for bacteria is one micro-millimeter, which is equal to one twenty-five thousandth of an inch. They are found everywhere except in the atmosphere of high mountains. They may enter the human body by means of the digestive tract, the respiratory tract, and the skin and mucous membranes if abraded, punctured or broken. Most of the species of bacteria are harmless, some beneficial and a few are dangerous and cause many of the ills to which

flesh is heir. They multiply with amazing rapidity and in three days a few germs would be capable of producing seventy-two billions of individuals. This will account for the suddenness with which disease may break out in the human being and, in some instances, kill with such rapidity. These low forms of life being so minute, it can be readily understood how they may be carried about by insects. It is calculated that a million of bacteria may rest on the point of a pin. Therefore a fly could carry many millions of germs on its feet and proboscis. Suppose a person with cholera should vomit on the street and the ubiquitous, excrement bred house-fly should settle on it and afterward fly into a dining room and rest on food, in all probability the person eating the food would acquire the disease.

It may be of interest to state what has been discovered in relation to insects and the deadly bubonic plague of the East. Flies die of the plague and when crushed have disclosed the bacillus or germ of plague in the bodies. These flies when crushed and injected into animals produce the plague in the animals. Flies fed with infected mice died with plague. The bacillus of the plague has also been found in fleas taken from diseased rats. Insects may transmit disease by transporting the germs upon their bodies and infecting whatever they alight upon, by inoculating the disease producing organism in biting or stinging. This method is just as certain of producing disease as the sharp needle of the hypodermic syringe is certain of puncturing the skin, providing the person bitten or stung is susceptible. Insects may also distribute disease by means of their excreta and they also serve as intermediate hosts for the development of the life cycle of certain disease producing organisms.

Until very recently it was thought that house-flies were essential, as their young, the maggots, eat a large amount of decaying and waste matter detrimental to the community. If we do away with this material ourselves, the house-fly looses its utility as a scavenger. If these flies distribute the germs of tuberculosis and typhoid fever, as they undoubtedly do, they are a menace to any community and should be destroyed, or still better, their existence prevented. A female fly will lay about one hundred and twenty eggs and they are nearly always deposited in fresh horse manure. The eggs hatch into maggots in about eight hours and after four days the maggots change into pupae. The pupa state lasts for five days and from it the perfect insect or fly emerges. Thus it will be seen that they go through their total life round inside of ten days and this provides for numerous generations in a summer. While horse manure is the principal food for the young of the fly, they will also feed on spoiled and moist food stuffs, decaying meat, cut melons, dead animals, human excrement, and excrement of poultry.

Now how can we apply our knowledge of the distribution of disease? Where do we find flies? Mostly on food stuffs in both city and country. Take a look into the dining room of many farm houses or notice the meat in the butcher shop during the summer months. One-seventh of all persons who die, die of tuberculosis, and tubercular sputum is distributed everywhere; in our city squares on the sidewalks in city and country, along roads and in many other places. The flies settle on it and convey it on their feet and proboscis to all kinds of food and to the very lips of invalids where the nurse or attendant are careless. In the dairy such material is conveyed to the milk pail and also to the food of cattle. How can we prevent it? By sanitatary measures that are after all only strict cleanliness. Horse manure should be immediately placed in receptacles that will not permit flies. to lay eggs in it. The floors of stables should be of such a character that will prevent the accumulation of this material in cracks. Knowing the life history of the house-fly gives the clue to its destruction.

Typhoid fever is frequently distributed by flies. In this disease the usual method of distribution is through the agency of the fecal matter from the person ill with the disease. In war times the gravest crime that can be committed is the deposition of excrement elsewhere than in the appointed latrines. During the late war the large amount of fever was undoubtedly due to neglect of this rule. Flies are sunshine-loving creatures and will not voluntarily go in dark places, therefore it is incumbent to have all privies and sinks absolutely dark in the places devoted to excrementitious matter. Food should be screened from them, especially in camps where typhoid fever exists. In the country, privies are sometimes constructed over streams and in other cases are open below and from the back; these are most pernicious as they permit access of flies at any time. These diseases come from a specific cause; their method of distribution is fairly well known; they are therefore preventable.

It has been discovered that the cause of malaria is a microscopic organism known as the Plasmodium Malariae. It is also known that certain mosquitoes by means of their bites inoculate human beings with this organism and they thereby acquire malaria. It is held by some observers that this is the sole source of this disease in human beings, but the writer is not prepared to say whether malaria is always so caused. The mosquito also disseminates yellow fever in the same way, and it is incumbent to know how to destroy the insect and how to protect ourselves from it. All the species of mosquito do not carry malaria but all are pests and have the same general habits. The young are aquatic animals and live in pools of stagnant water. The eggs are laid on the surface of the water and hatch in less than a day. The young of the mosquito come to the

surafce frequently to breathe and it is probable that they must come to the surface at least once a minute to get air. This is an important point to remember when methods of destroying them are discussed. The malaria carrying species has spotted wings, and when at rest, the attitude of the body is all in one line, while the common species are more or less angular or humped. The spotted winged species when resting on a wall, usually carries the body at an angle from the wall while the body of the non-malarial kind is carried parallel to the surface on which it rests. The hum of the two kinds is also different and can be readily told from the tone alone. The note of the harmless kind is high pitched, while that of the malaria carrying species is several tones lower. The mosquito is mostly nocturnal and it is necessary to protect ourselves at night by appropriate screens and by mosquito netting. The only practical methods of destroying these pests on a large scale are to fill up or drain their breeding places and to use kerosene on the surface of the water. If kerosene is flowed on water in the quantity of one ounce to fifteen square feet of water surface, it will kill the females as they strike the water to lay their eggs and it will kill any of the young as they come to the surface of the water to breathe.

It is necessary for the people as a whole to recognize the vital importance of these discoveries and to take concerted and intelligent action for their own protection, and the writer predicts that the day is not far distant when these diseases of man and also others affecting the lower animals will be materially lessened or even wiped out of existence. Economic entomology will also teach the farmer how to protect himself against the many species of insects injurious to vegetation even though at the present time he may not know what scientific research is actually accomplishing for his benefit. Knowledge is of slow growth and even slower in receiving proper recognition. As we have shown, it was more than twenty-two hundred years before humanity understood the real science of life as opposed to spontaneous generation, but in these times of universal education, knowledge is appropriated more rapidly and is being properly utilized for man's benefit.

BEE CULTURE.

BY DR. C. C. MILLER, *Marengo, Ill.*

VALUE OF HONEY.

Sixty pounds of sugar annually for every man, woman and child is the estimated consumption for the United States. Of course, many fall far short of that amount, but others as much exceed it. Among these latter may be found many a one who pays dearly for pandering too much to his sweet tooth. Excessive use of sugar has, in its train, a long list of ills, as sour stomach and various forms of dyspepsia; and it is also credited with being one of the causes of that dread visitant, Bright's disease of the kidneys. When cane sugar is eaten, it must be changed into grape sugar by digestion before it can be assimilated. If too much of this work is thrown upon the stomach, it rebels, and the work is passed over to the kidneys. If the kidneys are overtasked, there is no other organ to which the work can be transferred, and a breakdown is the result.

Yet the universal craving for sweets, especially among the young, shows that there is a real want which should be supplied. Fortunately, the want can be supplied without the dangers attendant upon the use of sugar. Instead of cane sugar, honey contains grape sugar, and its use brings no hard burden upon either stomach or kidney. Honey is nature's own sweet, delicately flavored as no confectioner could flavor it. To the natural taste of the child it is an esteemed luxury. Instead of an occasional indulgence, with the danger of a surfeit, children should be allowed honey as a daily food. A pound of honey will go as far as a pound of butter, and costs less. Bread and honey—not bread and butter and honey, but bread and honey—is a wholesome ration for a child, and a freer use of it would give us stronger men and women. Instances are not lacking in which those who have attained to an unusual old age attribute their long life to the daily use of honey. Whether they are right or wrong in their opinion, the fact remains that they have attained great age while making honey a regular article of diet.

So accustomed have we become to the use of sugar that we are likely to consider it an indispensable article, whereas for thousands of years sugar was unknown, honey being almost the sole sweet until within a few centuries, and many are now living who remember the time when the now commonly known granulated sugar was too high in price to be used as at present, daily in the poorest families. It were better for the health of the nation if in this respect we could go back to the former times, making honey take the place, at least partially, of sugar.

As a medicine, honey formerly filled a large place, and is still esteemed. In cookery, it has the distinct advantage over sugar that it has an affinity for moisture, and so honey jumbles and other dainties prepared with honey will keep months or years, whereas the same articles made with sugar would be dry and soon unpalatable.

BEES AS HONEY-GATHERERS.

For obtaining honey, we are entirely dependent upon the honey-bee. The amount to be obtained from bumblebees is so small as to be unworthy of consideration. Strictly speaking, the bee does not gather honey, but nectar. Compared with honey, nectar is a very insipid affair, and the bee performs the part of both cook and chemist in evaporating it down to the proper consistency, changing its cane sugar to grape sugar, and adding a minute quantity of formic acid. Flitting from flower to flower, busily gathering a very small quantity from each, never stopping to rest on a flower but for a fraction of a second, it fills its honey sac and hastens home to add its quota to the general store.

One uninformed would hardy credit the bee with the amount of labor performed and the distance traveled to obtain a load of nectar. Instead of searching for plunder near its hive, it often flies half a mile, a mile, two miles, and some believe that it goes from three to six miles from choice. A colony of bees, that is a family of bees occupying a single hive, may be kept on a very small piece of land, say two to four square feet, but if its flight were confined to that, or to an acre, or even ten acres, it would die of starvation. Of course, the case would be different if the ground were closely occupied with some great yielder of honey, such as buckwheat.

Taking the State of Pennsylvania as a whole, it is doubtful that there are many places where it would be prudent to put more than one hundred colonies in a single apiary. More than that would overstock the field. If now we estimate that the bees skirmish in all directions to a distance of two and one-quarter miles from home, the total territory occupied will be a little short of sixteen square miles —just about 100 acres to each colony.

BEES AS FLOWER-FERTILIZERS.

However important the work of the bee in securing the delicious honey, that is not its most important work. The honey-bee has been very aptly termed "the marriage-priest of the flowers." In order that fruit and seed may be produced, the pollen must be carried from stamen to pistil, this work being done in some cases by the wind, in others by insects, chief of which is the busy bee. Every observing farmer lad has noticed that on a cucumber, squash or pumpkin vine there are two kinds of blossoms, which he probably designates as "false" and "true." The true or pistillate blossom, before it opens, shows at its base the miniature fruit, which grows and matures, providing the pollen is brought from a false or staminate blossom. If the pistillate blossom be covered with mosquito netting, so that no insect can reach it to bring the pollen, the little fruit will "blast," or shrivel up and drop off.

Many plants, however, have what are called perfect blossoms; that is, stamens and pistils are found in the same blossom. Why should any go-between be needed in such a case? Even in this case, an all-wise Creator has so arranged that the pollen of any given flower shall not be used to fertilize the pistil of the same flower, for too close breeding of this kind is sure to bring deterioration. Take the apple. An apple blossom has stamens and pistils on the same flower. In order to fertilization, the pollen must be ripe, and the stigma of the pistil must also be ripe or in a receptive condition. It is wisely ordered that the times of ripening of the two do not coincide. So, when the stigma is ready to receive the pollen, no pollen is ready on the same blossom, and it must depend on having pollen brought from other blossoms. The honey-bee is the chief operator in this case. If a portion of an apple tree be enclosed in a netting at the time of blooming, the part thus enclosed will show very little fruit. If, at the time of blooming, the weather be rainy or bad, so that bees can fly but little or not at all, the apple crop to that extent may be counted a failure. If white clover blossoms be covered by netting, those so covered will mature only a fractional part of their seed as compared with those left open.

THE PROFITS OF BEE-KEEPING.

These are generally considered without any reference to the great profit of the bees in fertilizing plants, the value of honey alone being usually considered. Beeswax is, however, a product of no mean importance. If bees are left to themselves, it is not an uncommon thing for a colony to send out two or more swarms in a season. If we limit the number of swarms to two, that will triple the number of colonies. So a man who begins with one colony,

will have three colonies with which to begin the second year. Then he will have successively to begin each year, 9, 27, 81, 243, 729, 2,187, 6,561, and the tenth year he will begin the season with 19,683 colonies to work for him. A single colony has gathered 200 pounds of honey or more, and at 20 cents a pound, that makes $40.00 per colony, and the total yield from 19,683 colonies will give the snug sum of $787,329.00, to say nothing of all the crops he has had in previous years.

Certainly that looks very attractive on paper, and the glib-tongued patent-hive vender can add embellishments by saying that with his hive even better results can be obtained; that there are many cases on record in which 200 pounds per colony have been exceeded, and in some cases 500 or 600 pounds has been the figure. He may also say that three, four and even five or six swarms have been known to issue from one colony in a season. But there are some things he does not mention. He does not mention that the cases he gives are very exceptional cases; that instead of such a continuous flow of success, years of failure may be expected, in which the bees will fail to gather their own living, and will all die if not fed, and that the wonderful yields mentioned are very few and far between, occurring in remarkable localities that fall outside the State of Pennsylvania.

As a matter of fact, no such results as given in the figures mentioned have ever been obtained, and it is morally certain that they never will be obtained. If more than one swarm issues from a colony, the likelihood is that all after the first will be weaklings, of little value that will not survive the winter. If from any considerable number of colonies, a man obtains for a series of years an average of thirty pounds per colony, he has no reason to complain, and if his yearly average reaches fifty he has something to boast of. The man in search of a fortune need hardly turn to bee-keeping, and the number is small of those who depend on bee-keeping alone for a livelihood.

And yet it is true that in many a case there is nothing about a farm that pays better for the capital invested and the amount of labor involved than bee-keeping. If a professional bee-keeper near by has an apiary of fifty or more colonies, depending largely upon them for a living, it may be part of kindness and of wisdom for you to have nothing to do with bees. If the territory is already occupied by his bees, your flowers will be properly fertilized with no care on your part, and every additional colony you plant will be just so much taken from his income without a corresponding addition to your own. But if the territory is unoccupied, you may find profit in keeping at least a few colonies.

OVERSTOCKING THE FIELD.

For the number of colonies on any given territory makes a decided difference as to results, and it is not a very difficult thing to overstock the field. Suppose a man has in one apiary 50 colonies, and that they gather all the nectar within the radius of their flight, giving their owner a harvest of 40 pounds per colony. That makes a total of 2,000 pounds. But that is not all the honey those bees gather. In addition to the surplus honey taken, they gather enough for their own consumption, and that is estimated to be not less than 60 pounds per colony. So the 50 colonies would gather an additional 3,000 pounds for their own consumption, making the total amount of their gathering 5,000 pounds.

Now suppose this man's nearest neighbors on four sides of him should each plant an apiary of 10 colonies, making 40 colonies to be added to his, or 90 colonies in all to occupy the field. The total yield of the field is as before, 5,000 pounds. This, divided among the 90 colonies, gives less than 60 pounds per colony, or less than the bees need for their own existence, leaving both the man and his neighbors without any surplus honey, but obliged to feed to finish out the winter stores of the bees.

Localities differ greatly. One man in California has 600 colonies in one apiary. But that is in a remarkable locality, and it is just possible that he might get more surplus with a smaller number of colonies. The localities in Pennsylvania where more than 100 colonies can be profitably kept in one apiary are probably very few. In more places, from 50 to 75 should be the limit. One trouble in the case is that it is very hard to come to any definite conclusion. A given number may be all right for one year, then the next season will be so poor that half the number would give a greater surplus.

THE BEST LOCATIONS.

There are locations, however, where a few colonies may be relied upon to give a handsome return year after year. If you can find a place where there are very few bees within a range of two or three miles, and where there are many honey-plants blooming at different times throughout the season, you may count on a good crop every year. It is true that some good honey-plants bloom freely some seasons and yield no honey, and perhaps the next season, with no greater show of bloom, they may yield abundantly. But there is little danger that all will fail in the same year. If white clover is a failure, linden may more than compensate, or it may be a good year for buckwheat.

In this connection it may not be amiss to offer a word of caution. If you should strike upon a locality of this kind, and get an extra-

ordinary yield with only one or two colonies, do not make the mistake to think that because you get 150 pounds per colony you can count on doing the same thing if you should increase to 50 or 100 colonies. A great variety of plants helped to make that 150 pounds, some of them yielding only a small amount, but enough so that one or two colonies could find employment every day throughout the season. When you increase to 10 colonies, there will be days when the plants yielding at the time will yield no more than the bees need for their own support; and when you increase to 50 or 75, there will be only a short period when the bees get more than their living. It is a comfort to know, however, that when the harvest is rich, a short period will be sufficient to make a handsome return for all the year's work. In the State of New York, G. M. Doolittle reports a yield of 66 pounds of linden honey from one colony in three days. That is very unusual, but even with 5 or 10 pounds per day, it would need only a few days to make a fine return. The harvest from linden may last two or three days, or it may last three or four weeks.

KINDS OF HONEY.

There are as many kinds of honey as there are of plants from which it is gathered. It may be dark in color, then it may be light; it may be strongly flavored, or so mild as to be almost a pure sweet, and as varied in flavor as the different plants vary. Generally speaking, honey of light color brings the highest price, although there are persons who prefer the darker and stronger-flavored honey, for dark color and strong flavor are likely to go together.

White-clover honey is the great staple. In quality, the great majority of people will place it at the head. It also leads as to amount, taking the State at large. A stray blossom of white clover may be seen here and there toward the latter part of May, and in about ten days later the bees will be found busy storing from it. That is, if it yields honey. For it may bloom abundantly and the bees find no nectar in the flowers, because of atmospheric conditions, or for some other reason. In a good season the bees store most rapidly at a time when farmers just begin to complain of drought. Usually the white-clover harvest covers a period of three or four weeks, although it may be half as long, or it may be twice as long. Alsike clover exceeds white in yield. Sweet clover is coming to the front as an important honey and forage plant.

Linden, or basswood, also yields a white or very light amber honey, of a flavor that is highly esteemed, and in very many cases it is classed as white-clover honey. In rapidity of yield no other plant surpasses it, as already mentioned. With a good range of linden

timber, one may do fairly well with ten days of harvest, even if not a drop of surplus comes from any other source. Its usual season is July.

Buckwheat is the chief source of dark honey. In some locations it is quite reliable, yielding a rich harvest of dark honey, quite strong in taste and smell, while in others it is capricious, failing entirely to yield in some years. The daily yield from buckwheat is only in the forenoon. As it is not usually sown until July, it is classed as a fall honey-plant.

Fruit bloom and dandelions are important, not because they yield a large amount of surplus, for it is a rare thing to obtain surplus from them, but because they come early in the season to help fill up the hive with brood for young bees that shall be ready for the white honey harvest.

For the same reason the maples and the different varieties of willows are valuable.

Near the last of May the tulip-tree, which is also called whitewood or poplar, puts forth its beautiful flowers, which yield much dark honey.

Space forbids consideration of many other plants of more or less importance as honey-yielders, among which may be mentioned boneset or thoroughwort, catnip, cucumber, elm, figwort, ground-ivy, service-berry, locust, mustard, pleurisy-root, pumpkin and sun-flower.

Honey-dew is a secretion of the aphids or plant-lice, which the bees gather from the leaves of hickory and other trees. Some honey-dew is of fair flavor, but generally it is unfit for the table and disastrous to the bees if used for winter stores. Fortunately, the bees do not care to gather it when better stores are to be had.

POLLEN.

Pollen, the fertilizing dust of flowers, is gathered in large quantities by the bees, and although generally little valued by the bee-keeper, is indispensable to the bees. In the spring, if all pollen has been removed from the hive, no brood will be found until there is a supply of pollen from the early flowers, although adjoining colonies may have started brood-rearing in March or February. The nurse bees must have pollen or bee-bread, as it is often called, to prepare the pap that is fed to the baby bees. In order to carry pollen from the flowers to the hive, bees pack it in the pollen baskets on their hind legs. Then it is packed in cells at the outer part of the space occupied by the cluster of bees. The color of pollen varies according to the flowers from which it is taken, as yellow from dandelion and brown from white clover.

PROPOLIS.

Besides honey and pollen, bees gather propolis, or bee-glue, carrying it in their pollen-baskets. As the name bee-glue indicates, it is of a sticky nature, and is used by the bees to glue up all cracks and corners, although sometimes it is varnished over a plain surface, and even over the cappings of comb honey. It is possible that some day propolis may have a commercial value as a medicinal agent, but at present bee-keepers would be glad of a strain of bees that would gather no propolis. When the fingers of the bee-keeper become daubed with propolis, it cannot be washed off with water nor with soap and water. First, smear the part with a little butter or lard, rub well, then wash off all with soap and water.

BEESWAX.

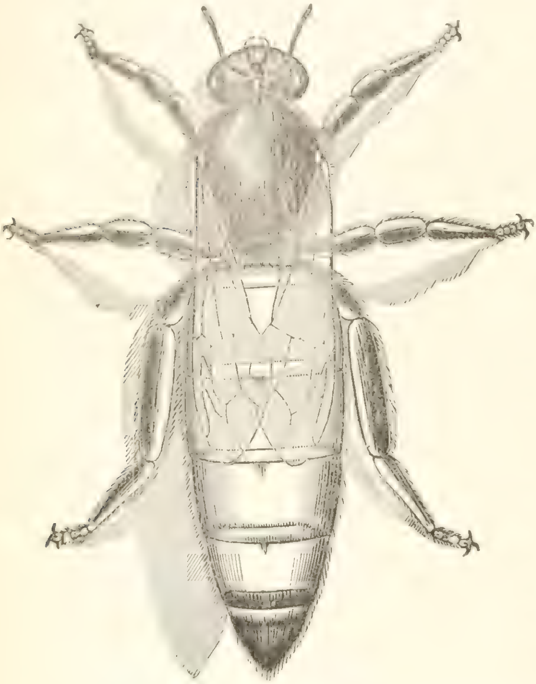
Bees do not gather wax, but secrete it a little after the manner in which a cow secretes milk. The wax is secreted in little flat scales between the rings of the abdomen, somewhat pear-shaped, and beautifully white. As commonly found in commerce, it ranges in color from a bright yellow to almost black. For the production of a pound of beeswax, it is estimated by some that twenty pounds of honey are consumed by the bees, and from that the estimates varies all the way down to three pounds. In any case, the cost is so much that the production of wax is not encouraged by bee-keepers, although as a by-product, if every scrap of wax be carefully saved quite an amount may be accumulated, for which there is always a ready market.

A COLONY OF BEES

Is a single family living together in one hive, working together in the most methodical manner, and each colony is separate from every other colony, each bee loyal to the interests of its own colony and ready at any moment to sacrifice its own life to defend its home against the attacks of other bees or of any other foes, man included. At the beginning of the swarming season a good colony will contain forty or fifty thousand bees, possibly twice as many in rare cases, among which will be found one queen, a few hundred drones, and thousands of workers.

THE QUEEN

Is not a queen at all in the ordinary acceptation of the term. She does not rule. Her sole business is to lay eggs. Beginning sometimes as early as January or February, she lays a very few eggs in the center of the cluster, and by and by the number is increased to 100 daily; then as the activity of the colony increases with warm weather, the daily laying increases to 200, 500, 1,000, and when all conditions are favorable, the hive being crowded with bees, the flowers yielding abundance of nectar, the daily output of eggs from one queen may be 3,000 or more. She continues laying until fall. But laying eggs is all she does. When busy at it, she does not even feed herself. The workers offer her food from time to time, and save her the trouble of digesting it by giving her that which is already digested. Nor are these eggs such very small affairs, for they are large enough so that the amount daily laid will exceed the weight of the queen's body, each egg being one-fourteenth of an inch long and one-seventieth of an inch in diameter. The queen is recognized by her longer body and comparatively short wings.



QUEEN.
(By permission from Root's A B C of Bee Culture.)

THE DRONES

Are the male members of the family. Beyond helping to keep up the heat of the hive, they are of no service whatever inside, their sole purpose being to fertilize the queen, the meeting taking place

high up in the air. The queen is fertilized once for life, and never again leaves the hive unless it be to go with a swarm, When the harvest is over, the workers withhold food from the drones and they soon disappear.

DRONE.

WORKER.

(By permission from Root's A B C of Bee Culture.)

THE WORKERS

Form the great bulk of the colony. They are smaller than the queen or the bulky drones, and are undeveloped females. Aside from the laying of eggs, they do all the work, bringing in nectar, water, pollen and propolis; secreting the wax and building the combs, and feeding the young, so soon to take their places. They are the only ones that sting. The drones have no sting. The queen has a sting, but she is as safe to handle as a fly, for she will sting nothing but another queen.

DEVELOPMENT OF BEES.

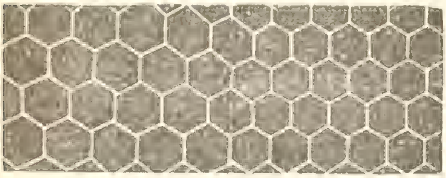
Three days after an egg is laid, a tiny white grub or larva hatches out of it. For about five days this grub is fed by the nurse bees, when it is sealed up and left to spin its cocoon and develop into the *imago* or perfect insect. Fifteen days from the time the egg is laid, the queen emerges from the cell. At five to eight days of age she is fertilized, and when eight or ten days old she begins to lay. Her span of life is generally two or three years, although queens have been known in rare instances to have lived five or six years. The

drone emerges twenty-four days after the egg is laid, and his lease of life depends somewhat upon the wealth of the harvest. If a continued dearth comes early in the season, his days are numbered. If there is honey to be gathered the whole season, his life will be spared until a killing frost, when his thrifty sisters will mercilessly drive him from the hive.

The worker emerges from the cell twenty-one days after the egg is laid. At a very early age she begins the duties of housekeeping, cleaning out the cells, feeding the baby bees, building combs, etc. Bees engaged in this work are called nurse bees. When sixteen days old, the worker begins to go afield, adding to the stores of the hive, and is then called a field bee. The length of life of a worker depends on the time of year when life begins: A worker emerging in June, when hard work is the order of the day, will wear itself out in about six weeks. An old bee is known by its ragged wings, and works until it dies. A worker emerging in September will live a half year or longer, as much of its life is spent in a semi-dormant condition.

HONEY-COMB.

A marvel of workmanship is the honey-comb constructed by the bees, of wax, consisting of a base or septum, with six-sided cells on each side. The greater part of the cells are one-fifth of an inch in diameter, thus making about twenty-nine to the square inch on each side, but as modified by man's interference, twenty-five to the square inch is nearer the mark. These cells are called worker-cells. Drone-cells are one-fourth of an inch in diameter, and there are about eighteen of them to the square inch.



DRONE-COMB. WORKER-COMB.

(By permission from Root's A B C of Bee Culture.)

Under normal conditions, an egg laid in the smaller or worker-cell will produce a worker, and one laid in a drone-cell will produce a drone. The difference in the eggs is that the egg laid in the worker-cell is impregnated and that laid in the drone-cell is unimpregnated. Worker-comb measures about seven-eighths of an inch in thickness (a little more when it is old), and drone-comb is about one and one-fourth inches thick. That is the measurement when the comb is used for brood-rearing. When used for storing honey it may be thicker, in some instances three inches thick or more. Worker-comb may also be used for storing pollen.

Queen-cells are constructed when needed, and differ entirely in appearance from other cells. A completed queen-cell looks a good

deal like a peanut, and is not far from the same size, having indentations over its surface like a peanut. Instead of opening sidewise, like a worker or drone-cell, it opens downward. When a young queen emerges from a cell, nearly the whole of the cell will be torn down within a few days, never again to be rebuilt.

It is estimated that a pound of wax will make enough comb to contain about twenty pounds of honey.

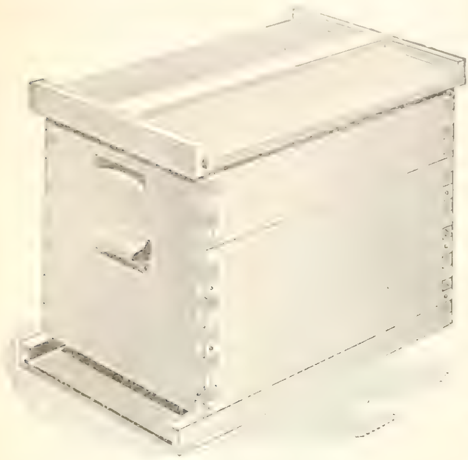
HIVES.

Until about half a century ago, the prevailing bee-hive was of conical shape and made of straw. From the standpoint of the bees' comfort, it is doubtful whether a better hive exists to-day. The practice was to brimstone in the fall the heaviest and lightest colonies, saving those of medium strength for a start the next year. It was a wasteful and barbarous practice, but even with all its wastefulness, it was profitable. The straw hive, or skep, was succeeded by the box hive. Strictly speaking, box hives came into use before straw hives went out. At first, box hives were used the same as straw hives, but later, surplus boxes or drawers were put on top, and surplus honey was taken out without murdering the bees. About the middle of the nineteenth century, Rev. L. L. Lanstroth invented the movable-frame hive, and to-day most of the hives in this country are of this kind. Each comb is built in a separate frame, so that each can be taken out separately, making it possible for the bee-keeper at any time to examine any part of the inside of the hive —a thing utterly impossible before the invention of Mr. Langstroth.

The kind of hive that is best to use depends a little on what the bee-keeper intends to do. If movable frames are never to be moved, there is not sufficient excuse for their existence. Bees will store as much honey in a box hive or even a nail keg as in a movable-frame hive, and will, perhaps, prosper better in the cheaper hive if having no care, but a hive with movable combs is much more convenient for the bee-keeper, and decidedly the better hive to have if he uses the movable feature.

Hives with movable frames are of various patterns, any of which may be profitably used. It is the man and the management that make differences in results more than the hive. But it is very undesirable to have more than one kind of hives in the same apiary, if you are to use movable frames. If you have a dozen box hives, it may be as well to have a dozen kinds. But one kind of movable-frame hive is enough, no matter what the number in the apiary. At least there should be only one size of frame, so that any frame in the apiary may be taken from its hive and put in any other hive.

The size of frame used more than any other, called the Langstroth frame (although any movable frame might fairly be called a Langstroth frame), is $17\frac{5}{8}$ inches in length and $9\frac{1}{8}$ inches deep. The most popular form of hive in which this frame is used is the dove-tailed hive, so called because its corners are locked together somewhat after the manner of dove-tailing. The body is little more than a plain box to hold the frames. The beginner will do well to start with the dove-tailed hive, not because it is so much better than all others, but because it is a sort of standard article, made by the thousands by supply manufacturers, and to be obtained at a lower rate, because standard, and also because it can be obtained at any time from some dealer in bee-keeping supplies at no great distance.



DOVE-TAILED HIVE.

(By permission from Root's A B C of Bee Culture.)

If you use box hives, it will be an easy thing for you to make your own hives. It does not matter if no two are exactly alike. But the case is different with movable-frame hives. Very few, indeed, are so situated, as to make a movable hive as good or as cheap as those that are made with the use of special machinery at the large manufactories. In most cases it is better to buy hives in the flat and nail them together yourself. The nailing is a simple matter, and the freight is much less on hives in the flat than on those nailed together.

Some of the advantages of movable combs may be mentioned here. Combs and bees may be interchanged from one hive to another, and the whole of the inside of the hive can be examined, whereas the inside of a box hive is a sealed book. The queen can be found, and if she is a drone-layer, or if the colony is queenless, the fact can be ascertained and steps taken accordingly. If increase is desired and the bees refuse to swarm, the bee-keeper with movable combs can make artificial swarms. Swarming may be to some extent controlled by giving additional room. The production of useless drones may be prevented by allowing little or no drone comb in the hive. Sometimes it happens that the wealth of a colony is its ruin. The combs are all filled with honey, and the queen has no place to lay. With movable combs it is an easy matter to remedy this. But it must be remembered that for the proper use of movable combs, intelligent information on the part of the bee-keeper is necessary, and if the

combs are never to be lifted out of the hive it is as well or better to have the bees in a box hive.

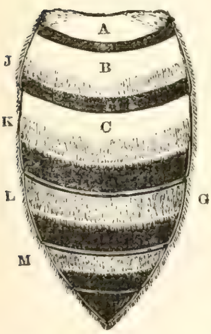
SIZE OF HIVES.

Much diversity of opinion exists as to the size of hives. A box-hive may contain about 2,000 inches, but some prefer a larger size. For 2,000 inches, a good proportion is to have the inside of the hive 12 inches square and 14 inches high. For extracted honey there is a pretty general agreement that a ten-frame movable comb hive is desirable, but for comb honey many prefer a hive of eight frames. But the eight-frame hive needs closer attention as to the matter of supplies, and the ten-frame hive is much safer against the danger of starving in winter and spring. Do not think of using less than ten frames, unless you expect to give close attention to your bees.

ITALIAN AND BLACK BEES.

The common black bee was first introduced into this country; but within the last half of the nineteenth century bees from Italy have become very common, and the Italian bee seems to be the popular variety. In size and form it is much the same as the common bee. The difference in appearance is found in the first three rings of the abdomen. The abdomen of a worker-bee, whether Italian or common, consists of six segments, one segment sliding into the other telescope fashion. When a bee is filled with honey, the abdomen is elongated and the segments show more plainly.

In the engraving is shown the abdomen or hinder part of a worker bee several times enlarged, in which the segments or rings of the abdomen are plainly seen. The segments A, B, C, are yellow in pure Italian bees that are imported from Italy. The four middle rings in all kinds of workers have the edges covered with light-colored down or plumage, as shown at J, K, L, M, but there is no down on the first or last segment. It is not this down, however, that gives the yellow color to the first three bands in Italian bees, but the horny substance of the segment itself. Some Italian bees have plumage that is nearly white instead of yellow, and these are called albinos. When the down is worn off, as in the case of robber bees, the bees become glossy black, the three first bands of the Italians of course being still yellow.



(By permission from Root's A B C of Bee Culture.)

In this country are to be found what are called golden or five-

banded Italians. They have been obtained by continued selection, so that instead of the three yellow bands there are four and five. They are very beautiful bees, but no better workers because of their beauty.

The important difference between Italians and black bees is in their deportment. It has become well settled that Italians are more industrious, even a small mixture of Italian blood helping to make a difference in the amount of surplus stored. They are more gentle, and with proper handling much less inclined to sting than the blacks. When a comb covered with bees is lifted out of a hive of blacks, the bees run in confused excitement, forming into a sort of rope and finally falling off at the lower corner of the frame, while Italians under the same circumstances remain quietly on the comb, and frequently the queen may be seen to lay while the comb is held in the hand. Italians are greatly superior in defending themselves against the incursions of the bee-moth. Indeed, the owner of Italian bees has no need to pay any attention to bee-moths.

The cross between Italian and black bees, called hybrids, will be found in many cases as good honey-gatherers as the pure Italians; sometimes better. Unfortunately, some of them will be found more vicious stingers than pure blacks. The workers of a first cross will be found to be partly black and partly with three yellow bands, or the bees may have one or two yellow bands. Although hybrids may be as good workers as pure stock, especially the first cross, there is a tendency to deteriorate, and it is well to have a pure queen to breed from.

OTHER VARIETIES OF BEES.

Carniolan bees have been bred to some extent. They are much like blacks in appearance, but the bands of light-colored down are brighter in the Carniolans. Some esteem them and their crosses as industrious workers, but their propensity to excessive swarming is urged against them.

Cyprian bees resemble Italians in appearance, and are good workers but inclined to be extremely vicious. Holy-Land and the Egyptian bees have been tried, but have not been approved. The general verdict is that for greatest profit in bee-keeping it is wise to have as nearly as possible pure Italians.

MAKING A START IN BEE-KEEPING.

If you have no bees, and desire to begin bee-keeping, you will do well to buy a full colony of Italian bees in a movable-comb hive, if you can conveniently do so. If none are to be had in easy distance,

you can certainly get them by ordering from some dealer at a distance, but they would have to be sent by express, and that would make them expensive. The expressage would be much less on a nucleus, that is a small colony covering only two or three frames, and such a nucleus could be built up into a strong colony, but so long as you have had no experience in that line it will be much better for you to begin with a full colony. If you want to be at all economical in the matter, do not send off two or three hundred miles for a colony of Italian bees in a movable-frame hive, but get the nearest to it you can get in your own neighborhood, if you can do no better than to get a colony of black bees in a box hive.

Whatever you may buy, you will do well to leave the selection to the man from whom you buy, if he is experienced and at the same time honest. If he lacks in either of these two respects, then you must do the best you can with your own judgment.

Even for the sake of getting a bargain, it will hardly be wise for you to start with more than one or two colonies. Let your numbers grow with your experience.

The probability is that spring is the best time for you to buy. If you have several from which to select, other things being equal, take the one that seems to have the most bees. Take one that feels heavy when you lift it, for a light one may not have enough honey for the bees. One which threw off a swarm the previous year will have the advantage of a young queen.

LOCATION OF APIARY.

The word "apiary" is used to express the place where bees are kept. It is also, and perhaps oftener, used to mean the bees with all their appurtenances, as "John has an apiary of twenty colonies of bees." If bees are wintered outdoors, and kept in the same place the year around, it is well that they be in a place sheltered from the prevailing winds. It will be well at the same time if the hives can be under the shade of trees. In the colder portions of the State, where it is desirable to cellar bees in the winter, a good place for summer is in the apple orchard. The shade is a good thing for both bees and bee-keeper. In hot weather it is all the better if the breezes have full sweep, but shelter for them is desirable in winter, as also in fall and spring.

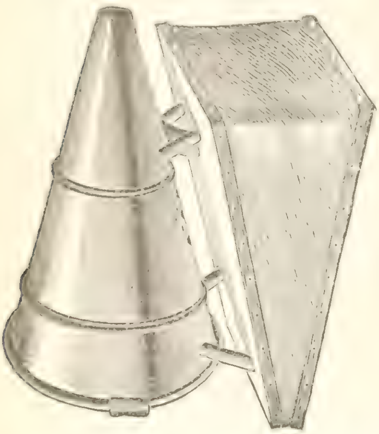
BEE-STANDS.

The former practice of having hives placed on benches or stands a foot or more high is no longer in vogue. In the height of the honey harvest many bees drop on the ground in the front of the

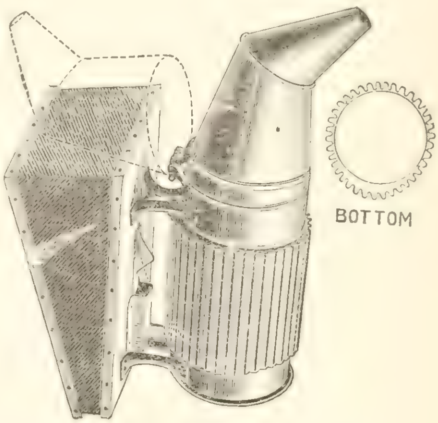
hive as they return from the fields, and they must rest there for some time before they can rise and fly to the entrance of the hive. If the hive is low down, they may crawl directly into the hive without waiting. If it were not for rotting the wood, a hive might be set directly on the ground. A good stand for two hives (it is well for hives to stand in pairs) is very simply made of common fence boards. Cut two boards four inches longer than twice the width of a hive, and two as long as the length of a hive. Nail the two short boards on the ends of the two long boards, and your stand is complete. Place the stand with the long boards uppermost, and you can put on it two hives side by side with four inches space between them. Level the stand from end to end, and let the front side be a little lower than the back side.

BEE-SMOKERS.

Before beginning actual manipulation of bees, it is well to be supplied with a bee-smoker. If you are addicted to the unfortunate habit of smoking tobacco, you may blow tobacco smoke upon the



CLARK COLD-BLAST SMOKER.



THE CRANE SMOKER.

(By permission from Root's A B C of Bee Culture.)

bees, but such smoke is rather severe. You may also have a pan of coals with wood burning upon them and blow the smoke from this with your breath, but it is inconvenient and not very satisfactory. A Clark bellows smoker can be had for fifty cents, and it is an excellent smoker, while it lasts, but if you have much use for a smoker it will be cheaper in the long run to get one of the best, as the Crane or the Bingham of large size, costing $1.25. A Cornell, however, costing seventy-five cents, is very nearly as good.

FUEL FOR SMOKERS.

It does not matter a great deal what fuel is used in a smoker, only so it makes a good smoke. As a starter, nothing is better than some

live coals from the cook-stove. When this is not convenient, a match may be touched to shavings, cotton rags, or rotten wood. A very convenient thing is to have some rags that have been soaked in a solution of saltpeter and then dried. Perhaps no fuel is better than sound hard wood, cut in pieces one quarter to one half of an inch square. The only objection is the trouble of preparing. Fine chips, gathered from the chip-yard, are good. A great variety of things may be used, and one may be controlled largely by the difficulty or ease with which the various things may be obtained. Among the many things that may be mentioned are, cotton rags, corn cobs chopped fine, leaves, planer shavings, peat, greasy cotton waste that has been thrown away along the railroads, hard-wood shavings from the turning-lathe, pine needles, etc.

Whatever be the fuel used, it is important that it be very dry, even if you have to bake it in the stove-oven. If it is at all damp, the fire will not keep good without constant blowing, and inky drops will fall from the muzzle of your smoker.

ANGER OF BEES.

Do not make the mistake to think that because smoke frightens the poor little bees you will use it unmercifully. Try to avoid arousing their anger. One thing that bees pointedly resent is rough jarring of the hive or quick motions. If you open a hive slowly and gently, you may, by using slow movements, lift out frame after frame without a veil or smoke, and if the bees are Italians and honey is coming in at the time you need have little fear of a sting. Go to the hive at a time when no honey is coming in, lift the cover with a snap, and roughly lift out the frames, and the probability is that you will beat a hasty retreat, for a number of bees will make a bee-line for your hands and face and leave their stings there.

So it is wise for you to be somewhat gentle at all times in dealing with the bees. Sometimes even a quick motion of the finger in pointing at them will draw a sharp attack. While you may get along without any smoke by being careful, unless you have abundant time to spend, it may be as well to give the bees a little smoke, enough to cause them to fill themselves with honey, for when bees have a wellfilled honey-sac they are likely to be good-natured, and then you can work more rapidly.

As already intimated, bees are of a better temper when they are busy gathering stores. In the cool of the morning or evening they are not so good-natured. If there is a sudden stoppage of the harvest, and robbers are troubling, you may find them like so many little demons, and the very next day you may find them gentle as flies because the honey-flow has started up again. If not too incon-

venient to do so, it is a good plan when you find them very cross to close up the hive and try it again when they are in better humor. The best time is generally in the heat of the day, the hotter the better if they are gathering.

Sometimes a lot of cross bees will follow you around, and it seems that all the bees are cross, when in reality the cross bees all come from one colony. By a little close observation you can find out which is the cross colony. It may be there is some excuse for its temper, as it may be queenless, and a strong colony that is queenless is not likely to have a sweet disposition. If, however, it is cross when others are good-natured, and there is no good excuse for it, the best thing is to kill its queen and give it one of better stock.

Do not get directly in front of a hive, thus angering the bees by interfering with their passage. Never strike at a cross bee unless you strike to kill. The quick motion of striking exasperates. If a cross bee follows you, and you cannot kill it, or do not want to, hold down your head and walk slowly away, and it will not be likely to sting you.

Remember that a bee stings only in defense of its home or its life. A bee out at work on the flowers can never be induced to sting you unless you catch it and pinch it. You may catch it and hold it in your hand all day, and it will never offer to sting until its life is threatened by your squeezing it. A bee will seldom follow you inside the door of a house, and if it should happen to get into a house, its only anxiety will be to try to get out again. If it should happen to get inside your veil, in nearly every case it recognizes that it is a prisoner, and instead of stinging turns its whole attention to making an escape, only to renew the attack the minute it escapes.

It is some comfort to know that if you have much to do with bees and are stung often, you become to a certain extent immune to the poison. A veteran bee-keeper may wear a veil to keep the bees out of his face, but his hands will generally be bare, for he prefers the little trouble of the stings to the discomfort of gloves. An old bee-keeper will tell you, "When I first kept bees, a sting on the hand would make my hand swell up to the shoulder, and I could hardly use the hand for a day or two; now if I get half a dozen stings on one hand in the morning, by evening I cannot tell which hand was stung, only as I remember it. Just for the minute, the sting hurts as bad as ever, but it only lasts a minute, and it doesn't swell."

The kind of clothing one wears among the bees makes some difference. Anything woolen irritates them, and the touch of fur makes them furious. Fortunately, one does not need to wear furs at the time when most work is done with bees. A smooth, hard

surface of linen or cotton is best. Light-colored clothing is better than black or dark.

BEE VEILS.

The novice is likely to fear stings so much as to desire to be clad in a bee-proof armor. But that is not very pleasant on a hot day. With light-colored cotton or linen clothing there is little fear of stings elsewhere than on the hands or face. The favorite point of attack seems to be the eyes. Some wear sting-proof gloves, but after some experience the inconvenience of gloves on a hot day is generally considered worse than the stings. Ladies, however, sometimes wear gloves to avoid the unpleasant feeling of having the hands daubed with bee-glue. Most bee-keepers prefer to wear a veil.

Any veil will do that will keep out the bees and at the same time not interfere with the sight. Black is the only color for a bee-veil. A light-colored veil may not only interfere with the sight, but may injure it. The thinner the stuff the better, only so it is strong enough.

A good bee-veil may be made of an open cotton material called bobbinet or cape-net. It is about twenty-one inches wide. A piece is cut off a little longer than the circumference of the brim of the hat over which it is to be worn, and both ends are sewed together. This makes a bag open at each end. A hem is made at each end and a rubber cord run through it, the cord being short enough to make a tolerably snug fit on the crown of the hat. When the veil is put on, take hold of the lower edge at the front, and draw it down quite tight, pinning it fast to the suspenders or clothing with a safety-pin. Silk tulle will make a nicer veil, but it is more expensive, and it tears more easily. It works nicely to put a face-piece of silk tulle in the veil of cheaper material.

TREATMENT OF STINGS.

When a bee stings you, in nearly every case the sting is left in the flesh and the poison sac with it. If you will quietly watch a sting thus left, you will see that it is constantly moving for a considerable time after the bee has left. While thus moving, the little muscles are accomplishing two things; one is to drive the sting further into the flesh, and the other is to pump more poison into the wound. You will readily see that the first thing to be done, then, is to get out the sting. If you take hold of it in the usual way to pull it out, you will squeeze the poison sac and squeeze more poison into the wound. Instead of that, take the thumb or finger nail and scrape out the sting.

The different things that have been lauded as cures for bee-stings count by the hundred. Perhaps nothing is better than a poultice of common mud. The experienced bee-keeper, however, does not often bother with anything as a cure, partly because he does not find that any of the cures make so very much difference, and partly because he does not want to waste time with them. He will tell you, "The very best thing to do for a sting is to get the sting out and then think of something else while you go on with your work."

SPRING WORK.

If everything has been properly done the previous season, very little work will be required by the bees in the spring. Those that have been outdoors all winter will need no attention, unless it be to have dead bees quietly scraped away from the entrance, and whatever has been done in the way of packing to keep them warm will be better undisturbed till weather is fairly warm.

Those that were wintered in the cellar must, of course, be put on their summer stands when the weather becomes sufficiently favorable, and it is not the easiest thing to decide just when that should be done. Somewhere about the time soft or red maples are in bloom will not be far out of the way. So long as the bees are quiet in the cellar, there is little danger from further confinement, and they are as well off there as to be out trying to get about in chilly weather when there is nothing for them to gather. But if they are uneasy, affected with diarrhoea, and spotting the front of the hives, it may be best to hurry matters a little. In that case they may be brought out early in March, if the case seems urgent, but never at a time when they cannot fly immediately after being taken out. If the air is still and the sun shining bright, this may be when the thermometer is at 50 degrees, but it is better to be warmer. If brought out when it is too cool, they will come out of the hives, become chilled, and many of them will never return.

Some warm days come in February or March when the thermometer in the cellar, instead of remaining at about 45 degrees, runs up to 50 degrees, or higher, and the bees become very uneasy. But a long cold spell may come after this, and it is better to persuade the bees to remain in the cellar. At such times, open at night all the doors and windows of the cellar, so the fresh cool air may freely enter. This will probably set the bees into a still worse roar, but do not be alarmed. By morning all will be quieted down, and the cellar can be again darkened.

When it comes time to take the bees out, and you are sure they can have a good flight the day they are brought out, let the cellar be opened all night the night before, so the bees will be quiet. If

they are inclined to be troublesome about coming out of the hives, enough smoke may be used to keep them in until the hive is set on its stand. Some are particular to put each hive in the same place where it stood the previous fall, but most bee-keepers pay no attention to this. If a few bees remember the old place where they were in the fall, and enter the wrong hive because they have changed places, no great harm will come of it.

FEEDING IN SPRING.

In spite of the fact that bees should be disturbed in spring as little as possible, it is better for them to suffer from disturbance than from starvation. If the right amount of stores were present in the hive in the fall, there will be no need of any anxiety, and the bees may be left undisturbed. Unfortunately, it will sometimes happen, especially if the hives are small, that there may not be honey enough in the hive to last till the bees can gather from the flowers. With box-hives, you can do no better than to heft the hives and *geuss.* If you guess they may run short of honey, you can put pieces of comb honey or candy under the hives, unless the hive is so arranged that it will be more convenient on top.

With movable-comb hives you can go at the matter more understandingly. With smoker alight, blow one or two light puffs of smoke into the entrance, lift off the cover, giving the bees a little smoke on top if they seem inclined to fly at you, but do not deluge the poor things with smoke unnecessarily. You wouldn't like smoke in your own eyes, and if your bees are gentle, and if your movements are gentle, very little smoke will be needed, possibly none. If you see sealed honey along the tops of the frames, you may feel sure there is no immediate danger from starvation, and it may not be necessary to lift out a single frame. If sealed honey is not to be seen, lift out one or more frames until you are satisfied as to how the case stands.

If you have been wise, you have on hand from the last season some frames of sealed honey, and one or two of these can now be given to any needy colony, putting the comb of honey close to the cluster of bees. The probability, however, is that no comb of honey is on hand. If you have no brood-comb filled with honey, it is possible that you still have some sections of comb honey that you had saved for the table. It may seem like extravagance to feed honey that may be worth possibly fifteen cents a pound, but having brought a colony through the winter, it would be very poor economy to lose several dollars by allowing it to starve now, rather than to feed twenty-five or fifty cents' worth of honey. But if you have not honey of your own, it is not wise to buy and feed honey as to whose source

you are in ignorance. If you should feed honey that had come from a colony affected with foul brood, it might mean the ruin of all your bees.

In any case, you are not restricted entirely to honey for feeding. Sugar will do, if properly prepared. Indeed, after bees get to flying in the spring, almost anything they will take in the line of sweets may be fed. Maple syrup will do. All things considered, perhaps the best substitute for honey is the best granulated sugar. It may be fed in the form of candy or of syrup.

CANDY FOR BEES.

Put into a tin sauce-pan a little boiling water and set it on top of the stove, but not so that the fire can directly touch the pan. Stir into this granulated sugar—in the proportion of seven pounds of sugar to three pints of water and let it come to a boil. Let it continue to boil, dropping a little of it occasionally into cold water, and when threads of it thus dropped break off brittle, take it off. Continue to stir it, and pour into shallow pans that have been greased, so that the cakes of candy will be an inch thick or less. These cakes may be laid directly over the frames in the hive, and then covered over with cloths, or in some way so that the heat of the cluster will not escape.

Another way is to put the candy into an empty brood-frame. Put a flat board on a level table, lay a piece of paper on the board, and on this put your frame, fastening it there with two or three nails, or by tying wire around board and frame. When your candy is cooked enough, take it off the stove and keep stirring it until it becomes so thick it will barely run, and then pour it into the frame. When it is entirely cool, it may be hung in the hive just like a frame of honey.

If you have some extracted honey, you can make a candy that is preferred, and it is less trouble to make. Take a very small quantity of the honey, heat it to less than boiling, and stir the honey and powdered sugar together to make a dough. Keep adding sugar and knead the same as you would bread dough, just as long as it will take any more sugar. Let it stand a day or two, and then you can knead in some more sugar. Cakes of this an inch or so thick may be laid on the brood-frames.

SYRUP FOR FEEDING.

Have on the stove a vessel with boiling water. Into this pour slowly five pounds of granulated sugar for every quart of water. Stir as you pour it in, for burnt sugar is very bad for bees. Cook

and stir till the syrup becomes clear, then take off the stove. There are several good feeders you can buy of dealers in bee supplies, but if you have none of these you can feed the syrup in combs.

Put an empty brood-comb flat in a tub or something of the sort, and pour into it from a height of four feet or so the syrup. It should fall in very fine streams, and for this purpose you may use an empty baking powder can, with its bottom punched full of nail holes. The hotter the syrup the more readily it will enter the cells, but if too hot it may melt the combs. If necessary, you can add water to thin the syrup, or you can use a larger proportion of water in the first place.

The crock-and-plate plan of feeding is less dauby and may suit you better. For this the syrup may be hot or cold, as it happens. Put the syrup into a common stone crock—a one-gallon crock is all right—cover over the crock one or two thicknesses of flannel or woolen cloth, or else five or six thicknesses of cheese-cloth, and over this put a dinner plate upside down. With one hand under the crock and the other over the plate, quickly turn the whole thing upside down, and set it on top of the brood-frames. A hive-body must now be put over and the hive-cover put on, so that no bee can get in from the outside.

It is better to do feeding in the evening, for if done earlier in the day robber-bees may be attracted.

SPRING OVERHAULING.

Having made sure that there is no danger of starvation, the bees may get on without further attention until it is time to put on surplus receptacles. Indeed, if the right care was taken in August or September, or even in October preceding, to make sure that abundant stores were in the hive, there may be no absolute need of attention from fall until summer.

With movable combs, however, it is considered worth while by many to give a kind of overhauling a little after the fashion of spring cleaning in house-work. The object is to see that all is right in every hive; that each colony has a good queen, and to make further assurance that there is no danger of starvation before the honey harvest comes.

Keep in mind that ten pounds of honey more than actually necessary will do no harm, while ten ounces too little means loss of the whole colony. You may be surprised to find how rapidly the honey in the hive will disappear after brood-rearing gets fairly under headway in spring. It is not enough that bees at such a time be given from time to time just what they will use. They seem to look ahead,

and will do more at brood-rearing if they know they have ample stores to nourish all the brood they may raise. So be sure they have not only plenty, but abundance of stores.

CLEANING HIVES.

In localities where propolis or bee-glue is troublesome, some think it pays well to clean the hives each spring, for in time they become so badly glued that it is not easy to move the frames. Set the hive to be cleaned to one side, and put in its place on the stand an empty hive that is clean. Lift the frames, bees and all, out of their hive, and put them in the hive on the stand. Brush or jar out of the hive the few remaining bees, and scrape it clean of bee-glue. A common hatchet is a pretty good tool for this purpose. This cleaned hive can be used to replace the next hive, and so on.

QUEENLESS COLONIES.

At the time of the spring overhauling, see that each colony has a good laying queen. If you find no brood in the hive by the last of April (and you will hardly undertake spring overhauling before this time), you may be safe in concluding they are without a laying queen. Such a colony is generally of very little value. It is not strong in bees, and what bees it has are probably old and dying off rapidly. Knowing that a queenless colony will rear a queen for itself if it has young brood given to it, you will be very strongly tempted to try to continue the colony, but please don't give way to the temptation. The queen they raise is not likely to be a very good one, and it will be more than a month before any of her progeny will be added to the population, which will be very weak by that time. The frame of brood you give them to raise a queen from will be quite a loss to the colony from which it is taken, and you will probably lose more than you will gain by taking it. Instead of trying to have the queenless colony rear a queen, break it up, giving the frames, bees and all, to other colonies. If the bees are smoked a little when these combs with adhering bees are given to them, there will generally be no fighting.

MANY BEES VERSUS MANY COLONIES.

Right here is a good place to emphasize the point that it is more important to have many bees than to have many colonies. The beginner is very likely to put the emphasis on the number of colonies. Let us consider the case in spring, when colonies are building up. Suppose we have a colony with only bees enough to fully cover one comb. Of course, that is the only comb in the hive in

which brood can be reared. Suppose this comb to be the third comb in the hive. The space between this third comb and the second comb will be filled with bees, and so will the space between the third and the fourth comb; that is, we have bees enough to fill two spaces. Now suppose we have twice as many bees, or bees enough to fill four spaces. That will fill the spaces between the first and second combs, and also the space between the fourth and fifth; so, although we have three combs covered with bees, it takes only twice as many bees as it took to cover one comb. You will now understand that if we have in a colony bees enough to cover three combs, that by dividing them into two colonies we would have more colonies but less brood, and brood is the thing we are very anxious to have, for brood is what makes bees. If you will observe in the spring, you will see that a colony with only bees enough to cover two combs of brood remains stationary until the weather becomes warm, while a colony with bees enough to cover four or more frames of brood increases in number right along.

When the weather becomes hot, a weak colony can do better at increasing, but when you compare the harvest from weak and strong colonies, even here it will be found that is desirable to have many bees rather than many colonies. If a colony with 25,000 bees stores a certain amount of surplus, one would be likely to conclude off-hand that a colony of 50,000 bees under like conditions would store twice as much. That would be an erroneous conclusion, for the colony with double the number of bees would be likely to store three times as much surplus.

One of the most common errors of beginners is to increase too rapidly in number of colonies, and one of the hardest lessons to learn is that many bees is the *desideratum* rather than many colonies. It is the strong colonies that count, either in rearing bees or storing surplus. The golden rule for bee-keepers has been said to be this: "Keep your colonies strong."

DRONE-LAYING QUEENS AND LAYING WORKERS.

You may find eggs and brood in all stages, and yet affairs may be in a desperate condition, for the brood is of such character that only drones will emerge from the cells. Nothing but blank ruin is in store for such a colony. When a queen becomes very old, and sometimes before she is very old, she may cease to lay worker eggs, laying only eggs that will produce drones. She will lay regularly in worker cells, but the outcome will be nothing but drones, smaller in size than usual because of their cramped quarters. It is not hard to distinguish a case of this kind. The first thing perhaps that attracts your attention is the unusual number of drones, but the

conclusive evidence is found in the sealed brood. Worker brood, when it is sealed, presents a flat surface; but if drone brood be in the worker cells, the cappings will be raised, looking much like a lot of little marbles.

But when drone brood is found in worker cells, it is not always the case that a bad queen is present. There may be no queen at all. When a colony has been queenless for some time, a number of workers may undertake the duty of egg laying, and such eggs will produce only drones. The cappings of the brood in worker cells will show the same raised appearance as in the case of a drone-laying queen. Even before any brood is sealed, you may tell the presence of laying workers by the way in which the eggs are laid. They are somewhat scattering, instead of having every cell regularly filled, as in the case of a good queen, and the laying workers have a preference for drone cells and queen cells. If you find drone comb filled with eggs while worker cells remain unoccupied, you may suspect laying workers. If you find two or more eggs in many of the drone cells, and especially if you find a whole lot of eggs piled into one queen cell, you may feel sure you have a case of laying workers. Often the first intimation of laying workers will be one or more eggs in a queen cell and no other eggs present.

Whether you have a drone-laying queen or laying workers, the remedy is the same; break up the colony and unite with others.

CLIPPING QUEENS.

At the time of spring overhauling is a good time to clip all queens that have whole wings. Not all bee-keepers approve of clipping queens, but a large number do. The advantage is that a swarm with a clipped queen cannot sail off to parts unknown if you do not happen to be on hand to take care of them. You may lose the clipped queen, but it is better to lose the queen than to lose both bees and queen.

There are two wings on each side. If you cut off two-thirds of the large wing on one side, the queen cannot fly. It is just as convenient to cut off both wings on one side, and it is easier to tell at a glance that such queen is clipped.

Be sure that you never clip a virgin queen. If you do she will never rear anything but drones, for she cannot fly out to meet the drones. As soon as a queen is found to be laying it is safe to clip her, for she is fertilized once for life.

A queen may be clipped with a pair of scissors or a sharp knife. In catching a queen, do not grasp her by the abdomen, which is

the hind part of the body, but by the wings or thorax. The thorax is the part next the head, and is not easily crushed because it is hard, while the abdomen is soft. You need have no fear of being stung by the queen. She has a sting, but will not demean herself by stinging anything less than royalty in the shape of another queen.

HUNGER-SWARMS.

Sometimes the beginner is surprised, and perhaps delighted, to see his bees swarming in early spring. But it is not because the bees are so prosperous that they can afford to send out a swarm in orthodox fashion. It is more likely that the bees have run out of stores; and such a swarm is called a hunger-swarm. It may try to force an entrance into some other hive, only to be killed there. The remedy, of course, is, to get the bees back into their own hive, if possible, and feed them.

SPRING DWINDLING.

Sometimes, for some reason not clearly understood, bees with plenty of honey and brood in the hive dwindle away in numbers, when no apparent cause can be found for it. The weak colonies are most likely to be the ones affected by this trouble. There seems to be no help for it but to wait for warm weather, when it disappears of itself. Some have tried uniting two or more such colonies together, but the united colony does not seem to last any longer than the colonies left separate, and in too many cases death puts an end to all before warm weather comes. Sometimes a colony thus affected may swarm out, but that can do no good.

STARVED BEES.

If you find a colony with no stores left, perhaps some of the bees already dropping from starvation, no time should be lost in giving them food. Even when all the bees appear dead, if the death from starvation occurred only a short time previous to their being thus found, they may yet be saved. Take them into a warm room and sprinkle them with well-sweetened water. In a little time they may show signs of life, and lick up the diluted sweet. When combs, bees and all are warmed and stores given, they may be returned to their former place.

TRANSFERRING.

Changing bees from a common box-hive into a movable-comb hive is called transferring. Such transferring may be done at any time, but until lately the favorite time has been at the time when fruit trees are in bloom. At that time there are fewer bees and less honey in the hive, and the bees will fix up the combs better while they are doing some work at gathering.

Have ready a board a little larger than one of the frames, and half a dozen or more strings for each frame, each string long enough to reach around the frame, and tie. Turn the box-hive upside down and set it down close by, putting the new hive in its place. Of course you will give the bees a little smoke at the beginning, and a little more at any time they show fight. Set over the box-hive an empty box that is somewhere near the same size, the open part of the box down. Drum on the sides of the hive with a heavy stick in each hand. If the hive and box do not fit well together, some of the bees may start to come out of the cracks. Smoke them in and keep on drumming. In a little while the bees will make a loud buzzing, which is not a sign of anger, but a sign of capitulation. They will then run up into the box, and when nearly all have gone up, lift off the box and set it on the ground, open end still down.

Now, with saw, hammer and chisel, as you may find necessary, split off one or more sides of the hive. Have your board ready with strings laid across it. Put the comb or combs on the board, lay a frame over, and mark with a knife where the inside of the frame comes. Take off the frame, cut off the part outside of your marking and then slip the frame over the comb. Let it be rather a tight fit, so it will be a little crowded in the frame. Now tie your strings. It doesn't matter if the combs are put in upside down. Sometimes it will be more convenient for you to put in some pieces that way. Lift up the board with the frame on it, and turn it so the frame will be right side up, and then remove the board and hang the frame in the hive. Now dump the bees down in front of the new hive and let them run in. They will be glad to find the comb there. Get out the rest of the combs and transfer all good, straight worker comb, rejecting drone comb and any that are too crooked. Some nice chunks of honey may be saved for the table. Fill up the new hive with frames filled with comb foundation. The bees will proceed to fasten the combs in the frames, and will gnaw out the strings.

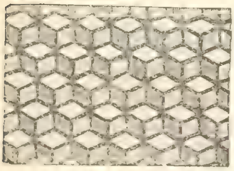
You will probably find it more satisfactory to take a different plan. Wait until the colony in the box-hive swarms, when you will hive the swarm in a movable-comb hive, putting the swarm on the old stand and the old hive two or three feet from it. If the colony

does not swarm by the time white clover is fairly in bloom, you may drum out the majority of the bees as already instructed, putting them in the new hive, just the same as a natural swarm. Twenty-one days after the colony swarms, or twenty-one days after the time of drumming out the swarm, drum out all the bees left in the old hive, and run them into the hive containing the swarm. At this time there will be no brood left, unless it be a little drone brood of no value, and there will be probably some honey in the hive. Set it somewhere about 100 yards from the apiary and close it up except an entrance large enough for one or two bees to pass at a time. The bees will clean out all the honey, and you can melt up the combs for wax, unless you find some nice, straight worker comb that you want to save.

If the bees do not swarm as soon as you desire, and you can obtain a frame of brood from some other colony, there is another plan that may suit you. Take from the stand the box-hive and set in its place the new hive in which you will put the frame of brood, and after filling up the hive with frames of foundation put a queen excluder over it. Drum the bees out of the box-hive and let them run into the entrance of the frame hive. Now set the box-hive over the other, closing up in some way any opening that may be between the two. Four or five days later look to see if there are eggs in the lower hive. If not, you have left the queen in the old hive, and must drum again so as to get her in the new hive. Three weeks after giving the new hive, the old hive may be removed and treated as before instructed, or you may leave it where it is till the bees have filled it with honey.

COMB FOUNDATION

Is much used in bee-keeping now-a-days. A thin sheet of beeswax is run through a foundation-mill, which embosses it in exact imitation of the base or midrib of honey-comb, as built by the bees.



COMB FOUNDATION

(By permission from Roots' A B C of Bee Culture.)

When this comb foundation is given to the bees, they accept it readily and build out cells upon it. This saves the bees time, labor and wax, and makes sure of having combs built just where they are desired. When used in the brood chamber, it makes sure that all the comb built upon it shall be worker-comb, a very important matter. If a strip of foundation only an inch wide be fastened to the top bar of a brood-frame, it will secure a straight comb by having the comb started in the right place, but most bee-keepers think it is

economy to fill the frame with foundation, for if only a small strip is used there will be entirely too much drone comb built.

If a full sheet of foundation is put in a brood-frame, supported only at the top, it will very likely stretch at the upper part so as to make the cells large enough for drone cells. To avoid this stretching, tinned iron wire, No. 30, is fastened in the frames, four horizontal strands. The frames that you buy will have the holes pierced through the end bars, and you will string the wire through these holes, fastening the two ends by driving in small nails part way, winding the end of the wire around the nail two or three times, then driving home the nail. The wire should not be drawn very tight. The sheet of foundation should be cut to come within a quarter of an inch of the bottom bar. Make a board just large enough to slip inside the frame. Keep its surface wet, so the foundation will not stick to it. Lay the board flat and lay the foundation on it. Then lay the wired frame over it. Push the foundation into the saw-kerf made for it in the underside of the top bar. To press the wire into the foundation, run over it a tracing-wheel, such as the women-folks use. To make it straddle the wire, every alternate tooth should be set like the teeth of a saw. A few drops of melted beeswax along the top will hold the foundation there, unless there comes with the frame a little strip to crowd in so as to wedge the foundation in tight.

To fasten foundation in the little surplus boxes, or sections, it will pay you to buy a foundation fastener if you have much of such work to do. If you use only a few sections, you can fasten the foundation by pressing down the edge with a common case-knife. The foundation should come within one-quarter of an inch of the wood at sides and bottom. The foundation must be warm enough to be a little soft, when fastening either in brood-frames or sections, as it will naturally be on a hot summer day.

Comb foundation is made of different weights. For brood-frames that are not wired, you need "heavy brood" foundation; for wired frames, "light brood." For sections, "thin super" is generally preferred, although some prefer "extra thin." The higher the foundation, the more it costs per pound; but you get more surface in a pound, so it is cheaper.

BUYING READY-MADE HIVES, ETC.

Time was when each man's clothes were made in his own house. Now-a-days it is usual to go elsewhere to buy them. No farmer would think of making his own reaper or hoe. It is the same way in bee-keeping. The manufactories that make a business of making

bee supplies can sell them for much less than you can make them for, or than you can hire them made for. Besides, they are better made. In making hives, sections, and in fact almost anything connected with bee-keeping, there is need of very great exactness, and supply manufacturers have fine machinery nicely adjusted, and, making by the hundred or thousand (some things by the hundred thousand), they can work everything to the best advantage. So you will find it the best way to buy everything ready-made, or at least ready to be nailed together. In fact, anything like hives or supers that must be nailed together would better be bought in the flat, as the freight will be less. In most cases, nails of the right kind and quantity will be sent with each order to put together the articles.

PUTTING ON SUPERS.

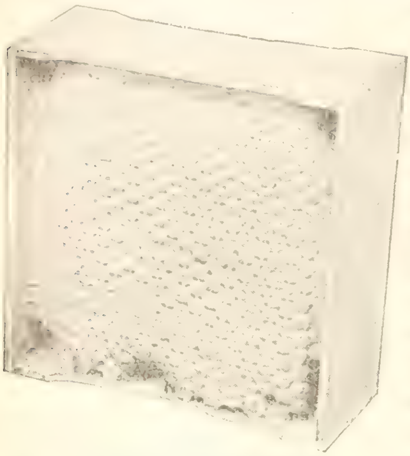
In most places in Pennsylvania, the principal harvest is from white clover and linden, or basswood. Fruit bloom, dandelions and many other things are of value, because they give the bees something to live on, fruit bloom being especially valuable because it helps to build up the colony in time for the clover harvest. Buckwheat, in some places gives a second harvest of dark honey. But it is not a sure thing that the bees can find nectar in the blossoms, even when the plants bloom abundantly. Just why, no one seems to know.

However, it is wise to be ready for the harvest, whether it comes or not. Receptacles for surplus honey should be on the hives a little before they are really needed. A common rule is to watch for the first appearance of patches of fresh white wax being plastered on the upper parts of the brood combs, and then put on supers. This will not do very well for box-hives, but you may use another guide which is all right for any kind of hives. Put on supers when you see the first white clover blossoms. The bees will hardly begin storing surplus until about ten days after the very first clover blossoms appear.

If you want to get surplus honey from a colony in a box-hive, you may make a box to cover the whole of the hive, the box being six inches deep, or you can make boxes large enough so that two or four of them will cover the hive. Have glass in one side of each box, so you can see when the box is filled, and fasten a little comb in the top as a starter. A cap or outside cover must be over all. To give the bees access to this surplus room, bore about eight one-inch holes in the top of the hive. Never mind if you do bore right into the combs and honey in the hive; the bees will patch it up all right.

SECTION HONEY.

But for movable frame hives (the only kind you will probably have after your first year of bee-keeping), you should use the little boxes that are so common, each section box containing somewhere in the neighborhood of a pound of honey. A look at the illustration shows how neat one of these sections is in appearance, and being of about the right size to put on a dish on the table, there is less daubiness than when a piece is cut from a larger comb. If you should ever have more honey than enough to supply your own table—a possibility that may be worth considering—you will find that in these sections it is in the most salable shape. A common size for a section-box is $4\frac{1}{4}x4\frac{1}{4}x1\frac{7}{8}$, but other sizes are also used, some of them of greater height than width. Supers, or receptacles for holding the sections, also vary. A full description of all the different hives, supers, sections, etc., would go much beyond the limits of this Bulletin.



A SECTION OF HONEY.
(By permission from Root's A B C of Bee Culture.)

SEPARATORS.

In order to have a comb of honey built in the right place in a section, it is necessary to have something to guide the bees, or they may build the combs crosswise. Comb foundation is used for this purpose, although a bit of nice, white honey-comb fastened in the top of the section will answer. To keep the comb within the right limits after it is started, partitions of wood or separators about one-sixteenth of an inch in thickness are used. If the honey is to be packed for shipping, most bee keepers consider it absolutely essential that the combs or sections be built between separators. Without separators the combs will bulge into one another, one side being thick and the other thin, and when these are packed together for shipment, bruising and leaking will result. If the honey is intended entirely for home use, you can do very well without separators.

BAIT SECTIONS.

Sometimes bees are a little slow about beginning work in sections, preferring to crowd the honey into the brood-comb. If crowded sufficiently in the brood nest, they will enter the supers, but this same

crowding leads to swarming, which is likely to interfere with the honey crop. The bees may be baited into the supers by having in the center of the super something more attractive to them than the bare foundation. Excellent for this purpose are the sections that were partly filled the previous year, emptied of their honey, and left over. If at first you have none of these, you may put a piece of honey-comb in a section. Still more sure to attract the bees will be a piece of comb containing brood. A section containing a piece of brood may not be so nice when finished, but it will be most effective as a bait, and you can easily afford to have a section in a super less presentable for the sake of getting the bees to begin work promptly in the supers.

But remember that unless the nectar is in the flowers, you need expect nothing in the supers. In a poor season you may have the bait section filled with honey and sealed, while every other section in the super is left untouched.

GIVING ADDITIONAL SUPERS.

Very likely your super will not contain more than twenty-four to twenty-eight pounds of honey, and in a good season this will not be enough room to suit the ambition of a strong colony. If you wait until this first super is entirely finished and ready to take off, much time will be lost, for it will take some time for the bees to finish sealing the sections after they are filled with honey.

Instead of waiting until the first super is finished, if the bees seem to be storing vigorously, give them a second super when the first is about half filled. Do no put this second super on the top of the first one, but under. If you have not a special hive tool, you may use a screw driver to pry up the first super, giving the bees a little smoke as it is raised up. Lift off the super, put the empty one on the hive, and on this the one you have taken off. No bait will be needed in this second super, for the bees will be obliged to go through it to reach the combs of honey upon which they have previously been working, and if they are in need of additional room you may be sure they will promptly begin work in the second super.

Even this second super may not be enough. Before the first super is ready to take off, three or more supers may be on the hive. So long as the bees keep busily at work, and you have reason to believe the harvest will continue, put an additional super on the hive, under the last one put on, whenever this last one is half filled. If you think the season may be near its close, and are uncertain whether to give another super or not, put it on the top of the others. It will do no harm there, and the bees will not use it if they do not need it. At best there will be some guessing in the case, for some-

times the clover harvest will close not much after the middle of June, while other years it may continue until the close of July. Sometimes the honey flow will let up as if about to close, then a few days later begin again. If linden trees are in fair numbers in your locality, you may count on their helping out the harvest during the first two weeks in July, or somewhere in that neighborhood. But, like clover, linden may vary very much in the length of its yield, and some years it does not yield at all.

TAKING OFF SURPLUS.

Comb honey is valued very much according to its appearance. To bring the highest price in the market, the comb must be snow-white. If it is left in the care of the bees after it is sealed, it will become gradually darkened on the surface. This does not hurt the honey itself that is in the comb; on the contrary the honey generally tastes better for being left in the hive all summer; and if it were to be eaten in the dark it would be well not to be in a hurry about taking it off. But to get sections off the hive with the whitest of combs, you must not even wait until all are sealed. If you wait until the sections at the outside corners are sealed, you may find that those in the center have become darkened. So soon as all but the corner sections are sealed, take off the super. If you have a number of supers taken off, you may take out the unfinished sections, put them all in an empty super, and put them back on the hive to be finished.

Taking off a super is a very simple matter; getting the bees all out is another story. If you have a Porter bee escape, put it at night under the super (the filled super to be taken off must be on top of all), and by morning very few bees will be left, when the super can be taken off. A super may be put in a tub or a big box, a sheet covered over it, and from time to time as the bees gather on the sheet, it can be turned over. Look out that you do not leave a hole for robber bees to get at the honey. A good many of the bees will leave the super and go below if you blow smoke into the super lively for two or three minutes before taking it off. If you are in a hurry to finish up the job, you may smoke all the bees out of the super after you have taken it off, brushing the bees off the super and sections as they come out. There is just a little danger that too much smoke may give a slight taste to the honey. At a time when bees are very busy gathering, you may set a super on top of a hive or beside it, and in the course of half an hour the bees will have left the super of their own accord. But it is a very risky thing to do this unless you keep a pretty close watch for the very first approach of robber bees.

BEE-BRUSH.

To brush off the bottoms of sections, a bee-brush is needed. You will also need one sometimes to get bees off brood-combs. You can shake most of the bees off a brood-comb, but the remainder must be brushed off. You can buy a bee-brush for a few cents, made like a whisk-broom of broom corn, only the corn is thin and not cut off at the ends. But if you don't care for the trouble of making one fresh every time, you can make one as good or even better out of asparagus tops, sweet clover, or any one of a number of different weeds. Get quite a bunch of it, and tie together with a string. If in a big hurry, you may grab up a big handful of long grass or weeds without any tying together. Of course, green brushes are good only for the day.

EXTRACTED HONEY.

In former days, besides comb-honey in irregular and dauby chunks, there was strained honey, secured by putting in a cloth a lot of crushed honey combs, pollen, brood and dead bees. When the honey was strained out of this, of course it was more or less flavored with the other materials. Now-a-days liquid honey, or honey out of the comb, is altogether different, being the pure honey with no extraneous flavor, just like the honey that drains out of a nice section of honey when it is cut and lying on a plate. This honey is not strained but extracted. It is thrown out of the comb by centrifulgal force, and the comb is left unbroken, so that it can be returned to the bees to be filled over and over.

As the bees have no comb to build, they can store the honey without hindrance, no matter how fast it comes. So the yield of extracted honey is greater than that of comb honey. The greater proportion of extracted over comb honey is variously estimated. Some say they can get sometimes nearly twice as much extracted honey as comb; others say they can get only a little more.

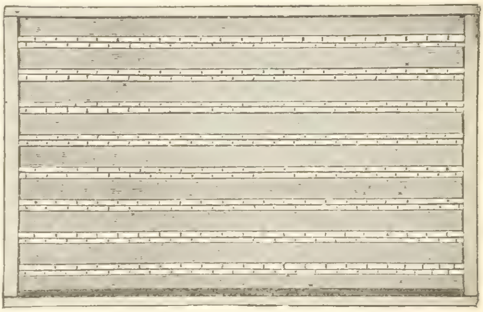
Aside from the greater yield of honey, there are some advantages in working for extracted rather than comb honey. It takes less skill to work for extracted. With a large hive and plenty of room there is less danger of swarming, when working for extracted honey. Sometimes, when the flow is short, the bees have not time to finish up any of their sections, and it is but little satisfaction to have a set of sections half filled. Even with the most skilful management there will be more or less unfinished sections. With extracted honey, it is different. No matter how little honey may be in the extracting combs, it can be thrown out.

Just on that account there is a danger. When honey, or nectar rather, is first gathered, it is thin, watery stuff, unfit for table use.

After being left in the hive it becomes ripened and rich. Some think it not advisable to extract till the honey is all sealed. At least a large proportion of it should be sealed.

EXTRACTING SUPERS.

Honey may be extracted from the brood-combs taken from the brood-chamber, and if care is taken not to turn too rapidly, the honey will be thrown out and the brood left in the cells. But it is better to leave the brood-combs undisturbed, and have a separate story or stories for extracting. These stories or extracting supers may contain combs shallower than those used in the brood-chamber, such shallow extracting combs being preferred by those that produce on a large scale, but being more convenient, it is a common practice to use extracting combs that are exactly the same as the brood-combs; indeed, the same combs are used sometimes in the brood-chamber and sometimes in the extracting-chamber. Some think that honey extracted from old black combs that have been used for years for brood-rearing is not so light-colored as that extracted from combs in which brood has never been reared. But there can be no very great difference.

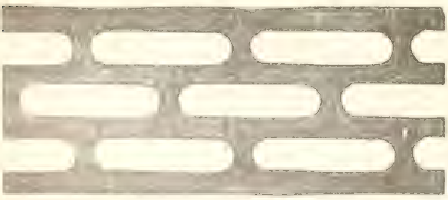


ZINC HONEY-BOARD

(By permission from Root's A B C of Bee Culture.)

In order to prevent the queen from going up into the extracting super, a zinc honey-board is used, called also a queen-excluder. This queen-excluder may be made entirely of zinc, but is usually made of alternate strips of wood and zinc.

The zinc is perforated with holes about one-sixth of an inch in diameter, the best size being considered 165-1000 of an inch. Perforations of this size bar the passage of a queen, while they allow workers to pass freely. The use of a queen-excluder makes it certain that there will be no brood in the extracting super. Neither need there be any fear lest the queen be lifted out when combs are taken for extracting.



PERFORATED ZINC.

(By permission from Root's A B C of Bee Culture.)

It may be remarked in passing that while it is considered very important to have a queen-excluder under an extracting-super, it is

not considered necessary to have one under a super for comb-honey. If the sections contain full sheets of foundation, the queen will very rarely go up to deposit eggs in them.

Some say they can dispense with excluders under extracting supers by having very thick extracting combs. In the brood-chamber the frames are spaced about one and three-eighths inches from center to center, and this same spacing is generally used in the extracting-chamber. If, however, a smaller number of combs be used in the extracting-super, and they are spaced one and five-eighths inches or more from center to center, the cells will be too deep to rear brood in, and the queen will not lay in them.

EXTRACTING HONEY.

A honey extractor, costing somewhere in the neighborhood of ten dollars, is a machine so constructed that the combs filled with honey may be put into the comb baskets, when they are whirled rapidly around in the tin cylinder, and the rapid motion causes the honey to fly out of the cells by centrifugal force, on the same principle that mud is thrown from the wheels of a vehicle when the wheels are in rapid motion.

Do not extract from a comb until it is sealed, or at least three-fourths sealed. Otherwise you will have thin, watery stuff, and in a little while your folks will say they do not care for honey. Unless you have had considerable experience, you will do well not to do any extracting except when the bees are busy gathering. They will then be good natured, and not inclined to sting or rob.

Give a little smoke, take out the comb to be extracted, shake off most of the bees and brush off the remainder, putting the comb into an empty super brought for the purpose. You can take the combs from each hive, empty the honey out of them, then put the combs back into the same super; but if you have several colonies it will be more convenient to operate differently. After extracting the first set of combs, take them to the second colony and exchange them for the full combs of the second colony, thus replacing each full set removed with the set you have just extracted. When the last set is extracted, it may be returned to the first colony.

Before putting the combs in the extractor the cappings must be shaved off, and for this purpose you need an uncapping-knife, made specially for the purpose, although you may use a common table-knife after a fashion. Some think it advisable to have a dish of hot water in which to warm the uncapping-knife, but with a sharp knife it is hardly necessary.

Some nice honey may be drained from the cappings through a colander. Then the cappings may be given to the bees to clean up

(look out you don't start robbing), or water may be added and the liquid added to the vinegar.

When combs are new and tender, and heavily filled with honey, there is danger that they may be broken if turned too rapidly in the extractor. A good plan is to turn rather slowly until about one-half the honey is extracted from one side of the combs, then reverse and extract all from the second side, when the remainder may be extracted from the first side.

SWARMING.

If the only thing to be done through the summer was to put on empty receptacles for the surplus honey, and then to take them off when filled, it would be pretty clear sailing. But just when prospects look most favorable for a good harvest, and bees are storing most rapidly, there is likely to be a sudden change in the program. The colony swarms, and the force left in the old hive is so weak that under ordinary circumstances nothing more is done in the supers. The swarm, if very strong, may do some good work in supers, but if the remainder of the season is not very good it may do no more than fill up its hive ready for winter. In any case the swarm and the mother colony together are not likely to yield as much surplus as the latter would have done alone had there been no swarming. An exception to this rule might occur in a locality where there was a large yield from buckwheat and other late honey-plants.

Left to its own devices, a strong colony is likely to swarm twice each season, sometimes three, four or more times. The first swarm, called also prime swarm, is likely to issue during the first part of June, when the white clover harvest is fairly begun, some swarms continuing to come later, and in rare cases a swarm may issue as early as fruit bloom. A first swarm may also occur during the fall flow, generally called a buckwheat swarm, but such swarms are not common. The old queen comes out with the first swarm, leaving no queen in the hive, but it is a mistake to speak of the queen leading out the swarm, for she does not generally leave the hive until a large portion of the swarm is out, and she may be among the very last. A swarm contains bees of all ages from the oldest to the youngest.

There is no certain way to tell beforehand when a prime swarm will issue without examining the brood-combs. Even then you may not be certain, but if you find a number of queen-cells, you may expect a swarm to issue when the first of them is sealed. It is easy to distinguish a queen-cell, as you will see by the illustration.

It is easier to foretell the issuing of after-swarms. About eight days after the first swarm issues, you may expect a second swarm, providing there are to be any after-swarms. Go to the hive the evening before the day you are expecting an after-swarm, put your ear against the hive, and if there is to be further swarming the next day you will hear piping and quahking. The young queen that is out of her cell utters a shrill succession of sounds, that sound something like "peep, peep, peep." The young queens yet in their cells answer very promptly, "quahk, quahk, quahk," in a coarser tone, and this piping and quahking is repeated at intervals.

QUEEN CELLS.
(By permission from Root's A B C of Bee Culture.)

If there is any swarming after the second swarm, the swarms will be only a day or two apart. These later swarms are likely to be very feeble affairs, sometimes hardly more than a teacupful of bees with the young queen. Such weaklings are only a nuisance, as it is hardly possible for them to survive the following winter.

HIVING A SWARM.

When a swarm issues from the hive and begins to sail aloft, there is sometimes a fear that it will immediately take its departure, and horns are blown, tin pans rattled, guns fired, etc., and then the swarm settles on some bush or tree. But it would settle just as well without any such racket. It is just possible that an after-swarm might go off without clustering first on some tree, but you need have no anxiety about a first swarm. Just let it take its time to settle; then you can proceed deliberately to house it in the hive prepared for it. You may cut off the small branch upon which it

is clustered, providing the value of the tree does not forbid, and it is not difficult of accomplishment; then carry the swarm to its intended hive, lay the cluster down directly in front of the entrance and close against it, and the bees will immediately begin to crawl in. If the tree is very high, the limb may be sawed off and let down by a rope.

Sometimes it is more convenient to jar down the swarm and let it fall directly in front of the entrance of the hive, the hive being placed in the proper position for the purpose. Let the hive be well raised in front so that there will be an abundant entrance. As soon as nearly all the bees are in the hive, so that you feel confident the queen is there, carry the hive to the stand you intend it to occupy.

It is the practice of some to use a peach basket on the end of a pole in which to catch the swarm. Hold the basket under the swarm, and with another pole jar the limb so the swarm will fall into the basket.

When a swarm is shaken from a limb, it is often the case that the bees will begin to cluster back on the limb again. To prevent this the limb should be constantly shaken in so lively a manner that the bees cannot settle upon it. This is tiresome work, and one way to make it easier is to have a rope. Tie a stone to the end of the rope, throw the stone over the limb, then let the stone slide down, and, holding both ends of the rope, shake.

SWARMS WITH CLIPPED QUEENS.

These must be treated differently. When the swarm issues, the queen, not being able to fly, falls to the ground. The swarm will sail around in the air and perhaps go back to the hive without settling, having recognized the absence of the queen. At other times it will settle, and may remain so a few minutes, sometimes even half an hour. If no one is on hand, the queen is likely to find her way back to the hive, and the swarm will also return, probably coming out again the next day. (If the queen were not clipped, no one being by, the swarm would probably leave for parts unknown.)

When the queen comes out, catch her and put her in a cage. The Miller introducing cage is very convenient for the purpose, but you can make a simpler one that will answer very well. Take a pine block 5x1x½ inches, and wrap around it a piece of wire cloth, four inches square. The wire cloth is allowed to project at one end of the block one-half inch. The four sides of this projecting end are bent down upon the end of the stick and hammered down tight into place. A piece of fine wire about ten inches long is wrapped around the wire cloth, about an inch from the open end, which will be near the middle of the stick, and the ends of the wire twisted to-

gether. Then pull out the block, trim off the corners of the end a little so that it will easily enter the cage, slide the stick in and out of the cage a number of times so that it will work easily, and the thing is complete. When not in use the block is pushed clear in, so as to preserve the shape of the cage.

Remove the old hive and put the new hive on the old stand. Lay the caged queen at the entrance of the new hive. When the swarm returns and a large part or all of it has entered the hive, let the queen out of the cage and let her run in with the rest. The swarm can now be moved to a new stand and the old hive returned to its place. The better way, however, is to leave the swarm on the old stand, as given under the head of prevention of after-swarms.

DESERTION OF SWARMS.

It is not an uncommon occurrence with the inexperienced to have a swarm leave a hive the next day after being hived, and if returned to the hive to repeat the process. If unobserved, and the wings of the queen are not clipped, it will leave for the woods. In the belief that it will prevent the desertion of the bees, some wash the inside of the hive with sweetened water, or rub it with leaves or something else to give it a certain odor. Nothing of the kind is needed. If a hive is not absolutely filthy, the bees will be satisfied with it if other conditions are right. In the great majority of cases the bees desert because of too great heat in the hive, or what is much the same thing, because there is too little ventilation. Shade the hive and give abundance of ventilation, and there is likely to be no desertion. Block up the hive so the entrance shall be two or three inches deep, and let the cover be partly off for two or three days. If there is no other way to shade the hive, take a good armful of fresh-cut hay, the longer the grass the better, lay it on the hive and put on it two or three sticks of fire-wood.

If you have movable-frame hives, you can give to the swarm a frame of brood, and with such a start in housekeeping it is not likely to desert, even if the hive be not the most comfortable.

PREVENTION OF SWARMS.

The prevention of a first swarm is not always an easy matter, if, indeed, it can be prevented at all. Being crowded for room is one of the things that perhaps more than anything else encourages swarming, so plenty of room does no little towards discouraging swarming. With hives containing ten or more Langstroth frames (a Langstroth frame is $17\frac{5}{8}$x$9\frac{1}{8}$ inches, outside measure) worked for extracted honey, and with plenty of room always in the surplus chamber, the hives kept comfortable by the shade of trees or its

equivalent, and with abundant ventilation, the amount of swarming will be at its minimum, some having no more than four or five colonies swarm out of a hundred. When hot weather comes, it is a good plan to put a block under each corner of the hive so as to raise it something like an inch.

The same means will do something toward preventing swarms when working for comb honey, but the number of swarms will be much larger.

The prevention of a second swarm is a more easy matter, and with proper care you may count pretty safely on preventing all swarms after the first. In order to understand fully the matter, it is necessary to explain a little about the habits of bees. On a summer day, if you will watch a colony of bees, you will see at some time during the heat of the day a large number of bees flying in front of the hive. They are flying about in circles, keeping close to the hive. They are young bees, some of them taking their first flight, and are out for a play-spell. Each bee, as it leaves the hive, turns its head toward the entrance, circling about with its head always toward the hive, circling farther and farther from the hive all the time, apparently noting carefully the hive and its surroundings. It is marking the location of the hive. When about sixteen days old it becomes a field hand, and then it acts quite differently. It wastes no time when leaving the hive, but shoots out in a straight line for the fields, and on its return comes back on the same bee-line directly to the location it has previously so carefully marked. If, while it is out in the field, you take away its hive and put another in its place, it does not look for its hive, but goes straight for its old place. More than this, if you take a hive from its stand and put another in its place, all the field bees of the removed hive, when they start to the field, will shoot straight out without noticing any change, and when they come back will go straight to the old location, even if they do not leave the hive for a day of two after the change has been made.

Another thing. Bees seem to know that if the honey harvest stops, they can hardly afford to swarm; and even after cells are started, if the yield ceases, they will tear down the cells and give up the idea of swarming.

Understanding these habits of bees, we may take advantage of it to prevent all swarming after the first swarm. When the first swarm issues, put the swarm in the place of the old hive, setting the old hive close beside it, both facing the same way. A week later take away the old hive and set it in a new place a rod or so distant. If other hives are sitting near, it is not necessary to move it farther than beyond the nearest hive. During the week since the swarming, a great many young bees have hatched out in the old hive, and it has

begun to feel quite strong. But after the removal all the field bees will desert it and join the swarm on the old stand. This weakening of the colony will greatly discourage the thought of swarming, and the discouragement will be increased by the fact that for that colony the harvest has ceased, for little or nothing is brought in from the field. So all the young queens but one will be destroyed and there will be no further swarming.

If supers were on the colony when it swarmed, they should be given to the swarm about two days after swarming. If put on immediately after the swarm is hived, there is some danger that the queen might go up and lay in the sections, but after a day or two she will have a brood-nest started below and will have no desire to go above. If extracting combs are in the super, then the super may be given as soon as the swarm is hived, as a queen-excluder will prevent the queen's going above.

CARE OF COMB HONEY.

It is by no means a matter of indifference as to how honey is kept, Especially important is the place. A common practice with those who know no better is to put it in the cellar. Before long the beautiful white sections begin to have a darker appearance; later on, small drops of sweetish water ooze out through the cappings, increasing in size until they run down in streaks over the surface. When the comb is cut open, the honey is found to be thin and watery, and in course of time it sours. Then the good woman of the house wonders what can be the matter with the honey.

She should know that honey has a strong affinity for moisture. The air of the cellar is moist, and that moisture is attracted by the honey. That's the whole trouble. Instead of putting the honey in a moist place, put it in the driest place. Wherever salt will not keep dry is not a good place for honey. In the kitchen cupboard is a good place; the higher up the better, because warmer. If you are fortunate enough to have an attic, where there is no covering overhead but the roof, and where, in the hot days of summer, it is so hot and close that you can hardly breathe, that's an ideal place to keep comb honey except in freezing weather. It will even stand the freezing of winter if it has stood in such a hot place during a considerable part of the summer. A hot and dry place is what is wanted.

Unless comb honey has had an extra chance to ripen, as in a hot garret, through a good many summer days, the effect of severe freezing is to make the comb crack across the surface. So it is desirable that in winter time comb honey shall not be subjected for a long time to severe cold.

CARE OF EXTRACTED HONEY.

It is easier to keep extracted honey in good condition than comb honey. If one goes to the trouble of heating it and sealing it up as fruit is put up, it may be kept for years, and may be kept in any place, dry or damp. But it will not do to heat it as hot as fruit is heated when fruit is canned. That would ruin it. Let it be fairly understood that the flavor of honey is a very delicate affair, and will be changed or destroyed by being heated beyond 140 to 160 degrees. The color also will be darkened by too much heat.

It is not necessary, however, to seal up extracted honey. It may be kept in stone or glass, or even tin, and if simply covered over it will keep all right unless it be in a damp place. In a damp place, it will attract moisture the same as comb honey, and in time will become thin and sour; but if it is well covered up the change will take place more slowly than with comb honey.

CANDIED OR GRANULATED HONEY.

There is one change, however, that is likely to take place with honey, whether comb or extracted. After a time, as cold weather advances, it changes from its clear liquid form and becomes granulated or candied. Some prefer it in this form, and, perhaps, more would if they became accustomed to it. Some of it can be made quite dry like candy. Turn a crock of it upside down, and let the liquid part drain off for a few days, and what is left will be dry like sugar, and can be done up in a paper package.

Most persons, however, prefer it in the liquid state. Fortunately, it can be restored to the liquid state without injury, if sufficient care is taken. Put it on a hot stove and let it boil, and it will be liquid—but ruined. It must not be allowed to get very hot. Give it *time enough* and it will become liquid without being kept very hot. All the better if it takes three days or more. One of the best ways is to put the crock of granulated honey on top of the reservoir of the cook-stove, and leave it there enough days to have all the granules melt. If you are in too much of a hurry to wait for that, take another plan. Set the crock of honey in a kettle of water, and let the kettle stand on the back of the stove so it will never boil. Of course, a pan will do in place of a kettle if more convenient. It will not do for the crock of honey to stand directly on the bottom of the kettle, for in that case it might be overheated. Let a piece of shingle or something of the kind be in the kettle for the crock to stand upon.

After a time the honey will become candied again, when it must again be liquefied in the same manner.

Cold hastens granulation; so does stirring. If liquid honey be put

in a dish that contains even a very little granulated honey, it will hasten the granulation of the whole.

Comb honey does not granulate so readily as extracted, but it is likely to begin granulating by the time it is a year old, especially if it has suffered from hard freezing. If it has been kept in a hot garret through the summer it may stand a good deal of freezing without harm. There is no way to bring candied comb honey back to the liquid form and still have it in the comb. It should be melted slowly without being overheated, as already described for candied extracted honey. Then when it has become cold, lift off the cake of beeswax, and you have a nice article of liquid honey for the table, unless it has become soured as well as candied.

TREATMENT OF SOURED HONEY.

The question may arise, what shall be done with honey, either in the comb or extracted, which has become thin or sour? In some cases it will be greatly improved by allowing it to stand a sufficient number of days on the reservoir of the cook-stove to get the benefit of the mild heat. Sometimes a crock of granulated extracted honey that seems quite bad may be made good. The surface is about as thin as water and somewhat soured, but farther down it is solid grains. Turn the crock upside down or on its side over another crock, and give it two days or more to drain off. Then melt slowly the solid part left, and there will be no sourness about it. Of course, there will be no need to melt it for those who prefer it candied, but the thin part must be drained off.

HONEY VINEGAR.

But even if the honey is so thin and sour that there is no possibility of making it fit for table use, there is no need of its being wasted. It can be used for vinegar, and it is a fact that the very finest of vinegar can be made from honey. When the thin, sour part is drained off candied honey, it can be thrown into the vinegar barrel. When honey is extracted, there will always be more or less honey in the cappings, and after there is saved for the table what will easily drain off, there will be still some left adhering to the cappings. A little water may be added to the cappings and thoroughly stirred up with them, and then drained off to be added to the vinegar. This draining will be more complete if it is done in a cellar.

Besides using such odds and ends for making vinegar, some think it profitable to use good honey for the purpose. It is said to keep pickles longer than other vinegar. Make water sweet enough with

honey so that when a fresh egg is put into it the egg will float, leaving above the liquid a spot about as big as a silver dime. Then treat as all good housewives know how, by keeping it where the sun can shine on it or in a warm place, with a chance for the air to get to it freely without a chance for flies to get in.

IMPROVEMENT OF STOCK.

Every farmer knows that there is a great difference in his cows, hens, etc., but there is too often a feeling that all bees are alike, and that bee-keeping is all a matter of luck anyway. If you observe closely, you will find that one colony of bees may give you good returns, while another sitting beside it does nothing in the surplus chamber. Bees are by no means all alike. They differ in disposition, temper, industry, and in other ways. It is worth while for you to have the best. Fortunately the change from poor to good stock may be made more rapidly than with other kinds of stock, and at less expense. By paying out a dollar or two for a queen, you may change a colony of poorest black bees to Italians. All you need to do is to send off your order to a reliable queen-breeder, such as advertise in our agricultural papers, and the queen will come by mail, with directions for introducing which you can easily follow. As a worker-bee only lives about six weeks in the busy season, and as the new queen will be laying from one to three thousand eggs in a day, you will see that if you get an Italian queen into a colony it will not be a great while until all the bees in the hive are Italian.

Even if you do not change from one kind of bees to another, it is generally a matter of advantage to introduce fresh blood occasionally. In any case, whether you get fresh stock from outside or not, whether your bees are Italians, blacks or hybrids, there is always something to be done in the way of improving your stock, so long as any one of your colonies is better than any other.

ITALIANIZING.

The probability is that you will want Italian bees, if your bees are not already Italian. The greater industry of Italian bees, and the greater amount of honey they will store in the course of the season, together with the fact that with Italian bees you need have little fear of wax-worms or moths in the hive, are sufficient reasons for preferring them.

For two dollars or so you can buy a *tested* queen. That means a queen reared from an Italian mother, the young queen having been kept until young workers have hatched out from her eggs, and

they show by the three yellow bands that the queen has mated with an Italian drone. If such a queen mates with a black drone, the worker progeny may have one or two yellow bands, or they may be mixed, some of them with three bands and some with none. When you have a queen from an Italian mother, the young queen having mated with a black drone, you have what are called hybrid bees, although it would be more correct to call them a cross. So, if you buy a tested queen, you will know that all the workers, drones and queens reared from her are Italians.

Perhaps you may prefer to buy an *untested* queen. She is reared from an Italian mother, and has begun to lay, but none of her progeny have yet hatched out, so it can not be told whether she has mated with an Italian or a black drone. The chances, however, are largely in favor, in most cases, of her being purely mated. In consideration of the fact that the breeder sends her out about three weeks earlier than if he had waited for her to be tested, he will charge you only a dollar or less for her. If it turns out that her worker progeny show the three yellow bands, then you are just as well off as if you had bought a tested queen, for your untested queen has now become a tested queen. It may be well to mention that the first of the yellow bands, the one nearest the head, is very small, and if you do not look closely you may not notice it, especially if the worker is not filled with honey.

In one respect the eggs of bees are different from the eggs of hens. If a white Brahma hen is crossed with a Langshan rooster, all the progeny, male and female, will be cross-bred. If an Italian queen is mated with a black drone, all the queens and workers raised from that queen will be cross-bred (hybrids they are called,) but the drones will be the same as the mother. In other words, the mating of the queen has nothing to do with kind of drones she produces. The explanation lies in the fact that each egg laid in a worker-cell or a queen-cell is fertilized by the queen at the time the egg is laid, but eggs laid in drone cells are not fertilized. It may happen on rare occasions that an egg laid in a worker-cell may not be fertilized, and that egg will produce a drone, and it is also possible that a fertilized egg may be laid in a drone cell, and from it a worker will issue, but with a normal queen such exceptions are very rare. The eggs of a laying worker, or of a queen that has begun laying without ever having mated, or of a queen so old that she has exhausted her store of fertilizing material, will produce drones, and drones only.

So it happens that if you get an Italian queen that has mated with a black drone, giving you workers that are half-blood Italian, you *may*, in the next generation, have workers that are three-fourths

Italian blood. For the queens you rear from that queen will be half-blood, and the drones full blood; so, if one of those queens mates with one of the drones, the resulting worker progeny will be three-fourths Italian. Having one Italian colony in the apiary, it is only a matter of time to get more or less Italian blood into your other colonies. But so long as your neighbors within two or three miles of you have black bees, you will find a constant tendency to work back toward black blood.

CONTROL OF FERTILIZATION.

It is a rather discouraging circumstance that anything like absolute control of fertilization has never yet been reached. The queen flies out of the hive to meet the drone high up in the air; and she may meet a drone from one of your own hives, but is more likely to meet one from some hive half a mile away, possibly three or four miles away.

Perhaps the nearest toward control has been something like this: Into the nucleus containing your virgin queen put the desired drones and put the nucleus in the cellar, the queen being at this time about four days old. Two days later, after drones have ceased flying, say four o'clock, bring out the nucleus and give it some diluted honey or sugar syrup. This will stir up the bees to fly, and there will be a prospect that the queen and drones will also fly. This is more trouble, perhaps, than you are willing to take, especially as you have nothing entirely sure.

But you may and ought to do something in another way, especially if you have quite a number of colonies. Decide which are your best colonies; from the very best one rear your queens, and allow the remainder of the best to have some drone comb, and keep all drone comb out of the other colonies. Then you will know that none but the best drones from your own apiary will be used, but must stand the chance of what your neighbors have, unless you can prevail upon them to co-operate with you.

KEEP RECORD OF YOUR BEST COLONIES.

How are you to know which are your best colonies? By keeping track of their performance, and putting it down in black and white. It is some trouble but it will pay you well. It is the belief of some that the right way is to measure the tongues of bees, and count those best which have longest tongues. The average length of a bee's tongue is perhaps not far from 13-100 to 15-100 of an inch; not long enough to reach the bottom of a red clover blossom. But some tongues have been found as long as 25-100, and if we could have

all our bees with such tongues we might get the many tons of red-clover honey that now go to waste.

Whether you do any measuring of tongues or not, you can keep account of the amount of surplus honey you take from each colony, and set it down at the time of taking from the hive, at least the approximate amount. The next year you can select the best for your queen-breeder, and a certain number of the next best for drone-rearing. One thing, however, must be taken into consideration, and that is whether there has been no change of queens in any of these colonies. The colony that gave you the largest amount of surplus last year may have superseded its queen last fall or this spring, and the young queen may have met a drone of poor stock, and from this you do not wish to breed. You can count only on those colonies that have made a good record and still have the same queen with which they began the season last year. You must also take into account any special advantages or disadvantages. If from colony No. 1 you took two frames of brood in the spring to give to No. 2, and you then found that No. 2 stored just a little more surplus than No. 1, it would not be fair to rate No. 2 as better than No. 1. The matter of swarming also comes in. A colony that has cast no swarm throughout the season ought to be expected to store more surplus than either the swarm or the mother colony that has swarmed—generally more than both together. Nearly always, however, it will be found that the bees that do the most work are the least given to swarming; so the swarming of a colony counts against it in making out its character.

In the ordinary course of management, where bees are left to their own way, and all the increase is through natural swarming, there will, of course, be the most increase from the colonies most given to swarming, which means that the general character of the apiary will run toward swarming rather than storing.

AN EASY WAY TO IMPROVE STOCK.

We want, however, to have the tendency the other way. There is a way in which a good deal can be done in the way of improvement, even by those most unskilled in the management of bees, whether the bees are in movable-frame hives or box hives. Having decided which one or two or three are the best colonies you have, watch for the first one that swarms. Suppose Nos. 1, 2 and 3 are your best, and that No. 4 is the strongest of the rest, and the rest follow in the order of their strength, 5, 6, etc. Suppose No. 2 swarms. Hive the swarm and put it on the stand of No. 2. At the same time put No. 2 in place of No. 4, and put No. 4 in a new place. All the field bees that were in No. 2 will join the swarm, making it

good for work. No. 2 will thus be deprived of its field bees, but on the other hand it will get all the field bees that belonged to No. 4. In about eight days No. 2 will have a young queen matured, and will send out a swarm. You will now proceed much as you did before. Hive the swarm and put it in the place of No. 2, and put No. 2 in the place of No. 5, putting No. 5 in a new place. The field bees of No. 5 will strengthen No. 2, and in a day or two it will send out another swarm. Proceed as before, putting No. 2 in place of No. 6, and so on as long as swarms issue. In this way you have, perhaps, no swarms from 4, 5, etc., but in their place you have swarms from No. 2, all of them having queens of your best stock. When No. 1 swarms, or No. 3, you can treat them the same way.

There is, of course, the possibility that No. 1 or No. 2 may not be accommodating enough to be among the first to swarm. With box hives you cannot do much to control this, unless it be by feeding the one you desire to swarm, but with movable-frame hives you may do much. Take frames of sealed brood from colonies that you do not want to swarm, and give to one of your best colonies, and you can thus strengthen it so as to hasten its swarming, while delaying the swarming of those from which the brood was taken. Of course, when you take these frames of sealed brood, you will merely exchange them for frames that have little or no sealed brood in them.

QUEEN-REARING.

Rearing queens has become quite a trade, and some bee-keepers make a business of shipping queens by mail to those who wish to purchase. Indeed, so important is the matter of queen-rearing, and so much of a science has it become, that an excellent book has been written which is devoted to that subject, "Doolittle on Queen-Rearing." Although it may not be desirable for the farmer with only a few colonies to go into the subject fully, he should know enough about it to rear queens at times for his own accommodation.

When a colony prepares for swarming, a number of queen-cells are started, eight, ten, possibly many more. As soon as the first one of these is sealed, the colony is likely to throw off a prime swarm. Six or seven days after this swarm has issued, the mother colony may be divided up into two or more parts, each part being called a nucleus, the word "nucleus" merely meaning a very small colony. (See the subject of nucleus farther on.)

Perhaps you will generally have enough queen-cells in each nucleus without any attention, but not always. Sometimes you will find a large number of queen-cells on one comb, and some combs without any. So it might happen that if you give the matter no atten-

tion you might have a nucleus without any queen-cell. Another thing must be considered. A large proportion of the queen-cells are built on the lower or outer edges of the combs. If these were left in the old colony without dividing, they might be all right. But when these combs are put in nuclei, it is harder for the smaller number of bees to keep them warm, and when a cool night comes, the bees will shrink away from the edges of the combs, and the queen-cells will be chilled. Hence, you must see that each nucleus has at least two or three good queen-cells where they will be sure to be inside of the cluster of bees in the coolest nights.

So you will cut away cells from the edges of the combs and from combs that have them to spare, and fasten them where desired. To cut out the cells, you may use a pocket knife with a sharp, thin blade that is more than an inch long. You need not cut away more than enough to get all the cell; but be sure you do not cut into the cell. Be sure you do not let one of the cells fall, for, while the young and tender queen is in the cell, a fall may cause a defective wing or leg. A defective leg would not necessarily destroy the usefulness of a queen, but a young queen with a wing so poor that she cannot fly is utterly worthless, for she must be able to fly until after she has made her wedding trip.

To fasten a queen-cell where you want it, use a long pin, or a slender wire nail an inch and a fourth or an inch and a half long. Push the nail through the base of the cell, but be sure it does not enter the cavity of the cell. Nail the cell right over some of the brood, for it will be more surely taken care of there than if separate from the brood. You will find that the bees build queen-cells with the point hanging downward, but it is not important that you should have them in exactly the same position. A cell will do just as well if lying on its side, and possibly as well if upside down. Still better than a nail to pin on a cell, is a staple such as a tobacco staple, the staple being an inch or more wide, with legs an inch long, although legs three-fourths of an inch long will answer. Lay the cell against the comb, put the staple over it so the cell will be at one side of the staple, and then sink into the comb the staple point that is farthest from the cell.

Possibly you may be inclined to think that because only one queen is to be reared in a nucleus, there is no need to have more than one queen-cell. That would be a mistake. While most of the cells reared by a colony preparing to swarm may be of the very best that colony can rear, it is not safe to assume that all are equally good. Some cells may contain poor queens, and some cells may contain nothing but a dead larva. So it is wise to have a number of cells in a nucleus—at least two or three. The bees will be likely to use the best. You will be able to see a difference in the appearance of

the cells, and while you are dividing the cells among the nuclei, you may as well see that each nucleus has its fair share of the best-looking cells. The best cells are generally among the largest and longest, and are deeply pitted over the surface. A stubby cell that is not pitted but has a smooth surface is not so likely to be good.

When the young queen is five to eight days old, she will fly out on her wedding trip, and about three days later she will begin laying. It may be well not to look for eggs till the queen is perhaps two weeks old, for at first the eggs are few and not so easily found. If you do not find eggs when the queen is two weeks old, you are not likely to find any later—the queen has been lost on her wedding trip or there is some other trouble. There have been cases where a queen did not lay until more than three weeks old, but such queens are not generally very good.

It is a good plan to give a nucleus of frame of eggs or unsealed brood when the young queen is four or five days old. If some bird has caught the queen on her wedding trip, or if some other ill has befallen her, such as entering the wrong hive, the bees will start queen-cells from this young brood, and by that you may know there is no queen present. This young brood seems also to have a sort of stimulating effect on the bees, and it is believed it may hurry up the young queen in her work of laying.

PRE-CONSTRUCTED QUEEN-CELLS.

The kind of queen-cells we have been talking about so far are those that are built in a hive while a laying queen is present. Besides preparing for swarming, such cells are built when the old queen is to be superseded. In the natural course of events, every queen is superseded by the bees when three or four years old, sometimes when the queen is only a few weeks old (although in such case it is probably because the queen is not a good one), and sometimes a queen is not superseded until five years old, and in rare cases a queen may continue longer. Something depends on the seasons. A queen in a large colony in a prosperous season will not live so long as one that has been in a small colony or that has had seasons when little work was done. These cells prepared by the bees while a laying queen is present, whether for swarming or supersedure, are called *pre-constructed* cells, and such cells are usually built on the edges of the combs, or where there is some hole or irregularity in the comb. The base of a pre-constructed cell is always rounding and not angular like the base of a worker-cell. When the young queen has emerged from a queen-cell, or has been destroyed in it, the cell will in a few days be torn down by the workers, leaving only the base or cup of

the cells. Such cell cups are frequently started by the bees and never completed, and you may find a number of them in almost any colony.

POST-CONSTRUCTED QUEEN-CELLS.

If a queen be taken from a hive at a time of the year when she is laying, the bees will proceed to rear a successor. A young larva will be selected in a worker-cell, more commonly a number of them, and fed lavishly what is called royal jelly. Scientists tell us that there is no difference whatever between an egg laid in a queen-cell and one laid in a worker-cell, also that the food fed to a worker-larva during the first three days is the same as that fed to a queen during the entire time of larval feeding. After the first three days a worker-larva is "weaned;" that is, it is fed a coarser food that is not so fully digested, but the queen is fed throughout on the better food, and fed so lavishly that generally quite a bit of the royal jelly is left in the cell after the young queen emerges. So the queenless bees feed the young worker-larva that they have selected, on the royal jelly throughout the entire feeding period, enlarge the cells over them, and the result is that what would have been workers had the queen not been removed now turn out to be queens. These queen-cells that are constructed after the larvae are first started in worker-cells are called post-constructed cells.

It is not easy to distinguish a pre-constructed from a post-constructed cell by looking at it from the outside, but you can always distinguish them by tearing down each cell and looking at its base. The bottom of a pre-constructed cell (the kind always used for swarming or superseding) is always smooth, like the inside bottom of a tea cup, while the bottom of a post-constructed cell (the kind always built when bees have lost their queen) is three-cornered, the same as the bottom of any worker-cell. The location of a post-constructed cell may be on the edges of combs, but sometimes they may be found right in the middle of a brood-comb, and in this case they may project so little above the surface of the comb as not to be seen on a hasty examination, and yet from such an inconspicuous cell there may emerge a nice, large queen.

As to the quality of queens from post-constructed cells. Taken as a whole, they are far inferior to others. The best of queens are reared only when weather and pasturage are at their best. You cannot rear a good queen when weather is so cold that bees can fly only every other day. Bees do not start queen-cells for swarming or superseding when weather and pasturage are unfavorable. Sometimes they start queen-cells preparatory to swarming, and the weather becomes very bad or the harvest ceases, upon which they

destroy the queen-cells and give up swarming until a more propitious time. But post-constructed cells are built as a matter of necessity; the bees feel that a queen must be reared or the colony will cease to be, so they proceed, no matter what the weather or harvest may be.

There is another reason why all the queens reared, because the bees are forced to rear them, are not as good as when there is no necessity in the case. As already said, for the purpose of rearing a successor when a queen is lost, the bees select a larva sufficiently young. Although only one queen is needed, several are started, so as to make the matter more sure. Not content with that, they continue to start queen-cells later on, even when no larvae sufficiently young for the purpose are present, and queens will be reared from larvae so old that they will seem part queen and part worker. Indeed, so desperate are the bees as to rearing a queen, that if they have nothing but drone brood they will try to rear a queen from a drone larva. Of couse, the poor fellow can be nothing but a drone, no matter how royally fed, and, generally, if not always, he dies in the cell.

While it is true that as a whole queens from post-constructed cells are inferior, it still remains true that some of such queens may be as good as the best. Let a queen be removed from a colony at a time when other colonies are swarming freely, and if that colony is left to itself there is no reason why it will not rear as good a queen as the very best it would have reared if the queen had not been removed and the colony had swarmed. The queen-cells first started will be all right, and as they will be first to mature there is no danger that the colony will have a queen from the poor trash started later on.

It is very important that this matter be fully understood; if queens are forced to be reared by unqueening a colony at a time when weather and harvest are not favorable, you need expect no good queens, and under the most favorable circumstances you can expect nothing but poor queens from larvae that were too old when selected; also, you may have the best of queens reared from proper larvae under proper conditions.

STARTING QUEEN-CELLS IN QUEENLESS COLONIES.

Understanding thoroughly this matter of post-constructed cells, it is easy to see that you may secure a lot of queen-cells by simply removing a queen from its colony. Do not think of beginning this too early in the season. It is time enough when bees begin to swarm. Neither should it be done after the harvest is over. You may, however, create an artificial harvest after the clover harvest

is over, by feeding the colony daily half a pint of honey or sugar syrup. But do not try this in the spring, for the weather is too cold then.

Do not make the mistake of thinking that a very weak colony will do to start cells. It is true that you may have a single frame of brood in a hive with bees enough to cover it, and have a cell started and a queen reared, but such queens would not be worth a cent a dozen. Remember that the queen is the keystone of all successful bee-keeping, and that you cannot afford to have poor queens, so you can well afford to have queen-cells started in a strong colony.

Of course you will want queens reared from your very best stock, so you will be likely to take the colony that has your best queen. Sometimes, however, it may happen that you may want more cells than your best colony would rear, and still you want to use that stock, or for some reason you may desire to rear from your best stock without disturbing its queen. In that case you may resort to *grafting*. Suppose you have made queenless a strong colony which does not contain your best queen. Two to four days later you will get from your best queen a frame of brood containing very young larvae, this frame to be returned after you have got what you want from it. Of course the weather must be hot enough so there will be no danger of chilling the brood. Go with this frame of brood to your queenless hive, take one queen-cell after another, take out the larva in the cell and put in its place a larva from your choice queen. A quill toothpick may do for a tool, or you may take a stalk of timothy and cut it in the form of a quill toothpick. You will find it an easy matter to get the larva from the queen-cell, and not very difficult to pick a larva—take a very small one—out of your frame of choice brood. Set this larva right in the jelly where the first larva was. The bees will generally treat the grafted larva just as if there had been no change.

One advantage about this grafting is that you may thus be sure that all your queens are reared from larvae that are not too old. It may be a good plan for you to mark each grafted cell, so you can be sure of their identification. Take a pin or, better still, a slender one and one-half inch wire nail, and thrust it into the comb directly over the cell.

GETTING QUEEN-CELLS BUILT IN A COLONY WITH A LAYING QUEEN.

As already stated, when a colony learns its queenlessness, it proceeds to rear a queen. It is also true that if one or more frames of brood belonging to a colony are so situated that the queen is some little distance from them, the bees on such combs seem more or less inclined to consider themselves queenless, and may take

steps to rear a queen. The more distant the queen seems from them, the more likely they will be to want to rear a queen. If a colony has two stories of brood combs, or even only a single comb of brood in the upper story, there being a queen excluder between the two stories and the queen being in the lower story, quite frequently the bees will start queen-cells on the brood above. If the queen be an old one that the bees are likely to be superseded shortly, the impulse to rear queens will be stronger.

While it is not safe to rely on the rearing of queen-cells in the way mentioned, it is tolerably safe to count on the bees rearing queens over an excluder if the cells are first started in a queenless colony. With an old queen about to be superseded, the per cent. of cells carried to completion will be large.

Queen breeders who make a business of rearing queens on a large scale make a practice now-a-days of using artificial cell cups in which a very young worker-larva is transferred or grafted, generally preceding the larva by a small amount of royal jelly, and a number of such cell cups, perhaps, to the amount of twenty or thirty, are fastened on a stick and put in an upper story, when the larvae will be fed in a royal manner, and the cells carried on to completion and sealed. To go minutely into the matter would be going outside the purpose and limits of this little work.

Of course it should be understood that a number of queen-cells may remain together in safety, but not a number of queens. One queen is all that can be kept in one inclosure, for queens, especially virgin queens, have a deadly animosity to one of their own kind. If you take away the queen from a colony, a number of queen-cells will be started, but if you wait about twelve days before opening the hive, you will be likely to find only one queen left. Either the workers have destroyed them, or they have fought it out among themselves until only one remains. It may be remarked in passing, as a curious fact, that in the combats of queens the victorious queen is not injured in the struggle. When the mortal sting is given by the victor, her vanquished opponent is in such a position that she cannot, or does not, sting her conqueror. So, if you want to save more than one young queen, you should remove the queen-cells about the ninth day, although the tenth day is usually pretty safe.

NUCLEI.

While it is practicable to carry on bee-keeping with full colonies entirely, it is many times convenient or economical to have a small number of bees in a hive, a very small colony being called a *nucleus*, the plural of nucleus being *nuclei*. Nuclei are especially desirable in the matter of queen rearing. Ten, twenty, or thirty queen-cells may

be in a hive together, but as soon as the young queens begin to emerge from their cells there must be a separate domicile for each. Something like two weeks will elapse from the time the queen-cells are taken until the young queens are to be used as laying queens, and sometimes it may not be convenient to use them then, and during that space of two weeks or more a young queen is just as well off in a nucleus of two frames as in a full colony. It is not well to have less than two frames of brood in a nucleus, experience showing that in a weaker nucleus the young queen does not do so well, being more likely to be slow in beginning to lay, and more often disappearing.

A small hive with frames much less than the usual size may do for a nucleus, but now-a-days it is considered better to use hives and frames of the regular size. The frames you have put in will be on one side of the hive, and you will hang beside them a dummy, in order to close them up. A dummy is merely a board of the same size as a brood-frame, having a top bar of the regular length. The thickness of the dummy may be anywhere from three eighths to one inch.

You may take from any colony two frames of brood with adhering bees and put them on a new stand in an empty hive, and you have a nucleus. But if you open the hive two days later you may be saddened to find every bee gone from your nucleus. The field bees all go back to the old hive the first time they return from the field, and as soon as the little colony discovers its queenless condition there is a commotion, and all the bees that had already marked the location at the old hive make their way back there. Those that are so young that they have never marked the old location become so discouraged and demoralized that they desert the hive, probably joining some of the nearest colonies.

So there must be some pains taken to make the bees of the nucleus stay where they are put. One way is to pen the bees in the hive so not a bee can escape. Stuff green leaves into the entrance pretty tightly. Next day pound the hive with the fist or a heavy stick for a minute or two, then open the entrance. The bees in their excitement will mark the entrance, and are then all right.

Another way. Take from a full colony three frames of brood with adhering bees and the queen, and put them where you want your nucleus to stand. Two days later return the queen and one of the frames of brood to the old hive. Take with this frame of brood only so many adhering workers as will leave the nucleus with plenty to cover the two frames of brood.

The matter will be very much simpler and easier if you have queenless bees to deal with, for such bees are quite likely to stay wherever they are put, and it is not difficult to have queenless bees at any time. If you do not happen to have any queenless bees, you may

proceed as mentioned in the last paragraph, only before you return the queen with the one frame of brood form what nuclei you wish by taking for each nucleus two frames of brood with adhering bees. Not many bees will return to the old stand, yet there will be enough so that if the queen on the old stand has only one frame of brood the colony will soon build up to respectable strength.

As a matter of economy, two nuclei may be in one hive. They will not only do as well as if in two separate hives, but they will do better, for there is a decided advantage in the mutual warmth. The greatest difficulty in the case is to have a perfectly bee-tight partition or division board in the middle of the hive. If there is a hole anywhere in, under or at the end of the division board large enough for a bee to crawl through, the two nuclei are likely to unite. Close up the entrance all but an inch or two at each end, so that no bee can enter except at these two places at the ends. Put the frames of brood next to the division board, so that the two nuclei will form a single cluster with the division board in the middle of the cluster. The division board ought not to be more than one-fourth to three-eighths of an inch thick.

BALLING OF QUEENS.

If without any preliminaries you put a strange queen into a colony that has a laying queen, or one whose queen has been removed only a few hours, you may count pretty surely that the queen thus introduced will be killed. If a strange worker enters a hive and is executed for its intrusion, the process will be short and sharp, the worker being immediately stung to death. Not so with a queen. One bee will seize it, then another, and another, until there is no room for any more bees to get hold of the queen, and then other bees will seize the bees that have seized the queen, the little cluster holding so firmly together that they are with difficulty pulled apart. This is called balling the queen, and the ball may be as large as a black walnut. When the queen has been balled a sufficient number of hours she will be found dead, possibly from suffocation, more likely from starvation.

If you find a queen balled and still alive, you may rescue her if you go at it in the right way. Do not try to pull apart the ball by main force. You may injure the queen, or the bees may sting her. If you throw the ball into a dish of cold water, each bee will do its best to save itself and the queen will be freed. Perhaps a better way is to throw the ball on the ground and blow smoke upon it from a smoker. Hold the smoker some distance from the cluster, so the smoke will be cool when it strikes the bees. If you blow hot smoke upon them, they will pretty surely sting the queen.

Sometimes bees ball their own queen that has been in the colony all her lifetime. This occurs more frequently in the spring. When you open the hive, the bees seem to be frightened, and whether to protect the queen or for some other reason, they ball her, and if you try to rescue the queen you will make matters so much the worse. Just leave the queen in the ball, close the hive as quickly and quietly as possible, and do not open it again for a day or so, and then you will almost surely find the queen safe and sound.

INTRODUCING QUEENS.

Getting a colony of bees to accept a strange queen—introducing a queen, as it is called—is an important matter in bee-keeping. Sometimes you will succeed with scarcely a precaution, and sometimes you will fail after taking great precautions. As a rule, bees will accept a strange queen only when they have been long enough without a queen to recognize their queenlessness. It is easier to introduce a queen when bees are busy storing. It is safer to operate in the evening, after bees have stopped flying, for earlier in the day they are on the lookout for robbers, and the queen is more readily recognized as an intruder. Bees that have no brood in the hive from which they can rear a queen are the more ready to accept one.

In the working season, when bees are busy storing, if a colony has been queenless two or more days, you may take from a nucleus a frame of brood with adhering bees, the queen among the rest, put the frame in the hive with no precaution whatever, and generally there will be no trouble.

If a queen be rolled in a spoonful of liquid honey so as to be thoroughly daubed all over, then dropped into a queenless hive in the evening between two frames so close together that she is in no danger of dropping to the floor board, she will generally be accepted.

Put a queen in a wire-cloth cage, and put the cage in the middle of the brood-nest between two frames, or directly over the top bars, and leave her there about two days. Then, upon opening up the hive, if you find the bees acting in a friendly manner toward her as if trying to feed her, you may release her from the cage. If, on the other hand, they act in a hostile manner as if trying to ball or sting her, leave her in the cage for a day or two longer.

Perhaps the majority of queens now-a-days are introduced by means of cages so prepared that the workers themselves will liberate the queens in the course of a day or two. Most of the queens sent by mail are in cages of this kind. There is an advantage in having the bees themselves liberate the queen, for when the bee-keeper himself opens the hive to do it, there is more or less excitement, which endangers the queen.

When a queen is not to be mailed but merely introduced, a cage simpler than the usual shipping cage will do as well or better. Miller's introducing cage can be had of supply dealers for 10 cents, or you can make one yourself as follows: Take a block 3 inches long.

MILLERS'S INTRODUCING CAGE.
From Root's ABC of Bee Culture.

$1\frac{1}{4}$ wide, and $\frac{3}{8}$ of an inch thick; two blocks 1 inch by $\frac{7}{64}$ by $\frac{3}{8}$ of an inch; two pieces of tin about an inch square; a piece of wire cloth $4\frac{1}{2}$x$3\frac{1}{2}$ inches; two pieces of fine wire about 9 inches long, and four small wire nails $\frac{1}{2}$ or $\frac{5}{8}$ of an inch long. That's the bill of material. Lay down the two small blocks parallel, three-eighths of an inch apart, one piece of tin under and one over them. Nail together and clinch. These two blocks, being three-eighths of an inch apart, make the hole to fill with good candy, through which the queen is liberated.

You will readily see that the queen can not get out of the cage until the bees have eaten out the candy with which you have closed the passage. The candy is of course packed in previously, and the large block is to be pulled out to admit the queen. In order to make the time longer for the queen to be liberated, it has become the practice to tack a piece of rather thin pasteboard over the place where the workers are to get at the candy. A few small perforations are made in the pasteboard, or else it is nailed on so that it does not entirely cover the candy at one edge. This tempts the bees to get at the candy, and they will spend perhaps a day in gnawing away the pasteboard.

While not more than one queen in a hundred may be lost in the plan last described, still it is not entirely certain, although perhaps the safest of the plans mentioned. If a valuable queen is to be introduced, it may be worth while to use a plan that is more troublesome but entirely safe. Put into an empty hive two or more frames of brood with young bees just hatching out, but with no unsealed brood. Put the queen in this and close the hive bee-tight, and keep it in a warm room for five days. By that time a respectable force of young workers will be present, and the hive may be placed on the stand where it is to remain and the entrance opened. As a matter of precaution against robbers, make the entrance large enough for only one bee to pass at a time. Instead of taking the hive in the house, it may be placed over a strong colony with wire cloth between the two hives to prevent passage from one hive to the other.

When a colony has been queenless long enough to have queen-cells well under way, it is not so easy to introduce a queen, and when it has become so hopelessly queenless that a greater or less number of workers have assumed the duty of egg-laying it is hardly worth while to attempt the introduction of a laying queen. That is one of the reasons why it is advised to break up a colony with laying

workers. Such a colony may, however, accept a queen-cell, and some have reported success by dropping into the brood nest a virgin queen not more than an hour or two old. It is a curious fact that while bees are so loyal to their own queen that they will not tolerate the presence of a stranger, a very young virgin queen may be put into any hive without being molested so long as she remains young. As soon, however, as she attains a little age, perhaps when a day or two old, she is no longer tolerated, perhaps, because at that age she begins to feel the royal blood stir within her, and has sinister designs upon the reigning sovereign.

TWO QUEENS IN ONE HIVE.

While it is the rule that only one queen will be allowed in a colony, it is not such a very uncommon thing to find a mother and daughter laying peaceably side by side. This will be in a case where the old queen has become superannuated and yet lingers on a short time after her successor begins to lay. But in a few days the older queen is likely to be missing. The possibility of such a thing should be thoroughly understood, for sometimes it may happen that a queen is bought and lost on being introduced, just because the owner had killed one of the queens without suspecting the presence of the other. It is well to have the wings of laying queens clipped, for then one has a chance to tell something about it when there has been a change of queens. While there may be such a thing as two queens not mother and daughter being in a colony at the same time, the case is very rare indeed.

ARTIFICIAL INCREASE.

While the majority of those who keep bees on a small scale depend upon natural swarming for increase, there may be circumstances that make it desirable to increase without depending on swarming. There is a great difference in different bees as to the tendency to swarming, as a general rule, the best workers being least disposed to swarm, and some think it not entirely impossible that we may yet breed a strain of bees that will be practically non-swarming. They say, "Non-sitting hens have been bred, why not non-swarming bees?" Even as it is now, there are colonies that have not swarmed for several years in succession. In such case it will not do to depend entirely upon natural swarming. Indeed, it may be desirable to resort to artificial increase even when there is all the amount of increase desired from natural swarming. For it is not merely the amount, but the kind that must be considered, and the colonies most inclined to swarm are not likely to be the best workers, while the

best workers, the very ones we want to breed from, are the ones that give the fewest swarms.

Fortunately it is not a difficult thing to multiply colonies without any natural swarming. Indeed, such multiplication is altogether too easy for most beginners. No other mistake is so likely to be made by the novice who has once made a beginning at artificial increase as to increase too rapidly. He closes the season with a large number of colonies, to be sure, but they are weaklings that will not endure the winter, and the following summer finds him no farther ahead than a year previous. If, instead of making a three or four-fold increase, he had been satisfied with an increase of 50 per cent., he would have got on more rapidly in the long run. There are two things that can hardly be insisted upon too much for a beginner to observe: 1. Go slow in the matter of increase. 2. Be sure that every colony before winter sets in has abundance of stores.

Knowing that bees without a queen will proceed to rear one if they have young brood present, the beginner will understand how easy it is to start a new colony. He need only take part of the brood and the bees from a hive and put them in a new place and the work is done; the bees will do the rest. And if the colony be divided up into two or more parts, there will be more new colonies; so, if there are eight frames of brood in a hive, he will start eight new colonies, each one having one frame of brood. In the course of time he will learn that all is not gold that glitters. If no precautions are taken, the bees will not stay with the brood when put in a new place. Some of his little colonies will fail to rear queens. Some of them will rear queens that will disappear before they get to laying. Those that do succeed in rearing queens that lay will have queens of little value. So he will be worse off than if he had attempted no increase.

Before attempting any considerable increase in the way indicated, it would be well to study carefully what has been said about queens and nuclei. Remember that the queen is the soul of the colony; that without a good queen there is no such a thing as success, and that a good queen will not be reared by giving young brood to a mere handful of bees.

It would take up entirely too much space to give all the plans for artificial increase, or artificial swarming, as it is sometimes called. A few may be given here, and the reader will be the judge as to what will best suit his needs. With experience, other plans will suggest themselves, or modifications and combinations of these.

SIMPLE DIVIDING.

About the simplest of all ways is to take one-half the combs with adhering bees from a colony and put them in an empty hive on a new

stand, filling up the vacant space in each hive with frames filled with foundation. No matter which half the queen is in, the other half will have bees enough to rear a queen.

While it may be all right to do nothing more, leaving the bees entirely to themselves, it will be a much safer plan to take a little more pains, and thus make more sure of success. Let us give a little attention to what will be done when this division is made. Suppose the queen is left in the half that remains on the old stand. The bees in the other hive, feeling keenly their queenlessness, will, mostly, within the next forty-eight hours return to the old stand, leaving so feeble a force of workers that the brood may be chilled. and such a feeble, discouraged lot of bees can not be expected to rear a good queen. The matter may be helped by fastening the bees in the hive for a day or two. thus leaving a stronger force in the hive, but during that day or two no honey will be carried into the hive, and no colony will do its best at queen-rearing when there is no harvesting coming in.

Suppose the queen is taken with the bees that are moved to the new stand. In that case there will not be the danger of such wholesale desertion, but still all the field bees for the next two days or so will leave the queen and go back to the old stand. That will work well for the queenless part, giving them a chance to rear a good queen, for the bees will be strong in number, and plenty of honey will be coming in. But it will be about three weeks before the young queen will be laying, and it would be most profitable if the laying queen could be with this stronger force of bees during that time.

A compromise can be made. We want the young queen to have the best chance, the most important time in her rearing being the time when she is fed in the larval state. So leave the queenless part on the old stand for a week, then let the two hives swap places. That will give the old queen on the old stand the strongest flying force allowing a better chance for work in supers. But after a little experience you will not be likely to use this plan.

THREE COLONIES FROM TWO.

A plan that is nearly as simple, and that is at the same time safer as well as giving a better chance for a honey crop, is to use two colonies so as to get a third from them. Suppose two colonies strong in bees, A and B. If conditions can be exactly to our liking, A will have a queen of the best stock, and B will be the strongest colony in the apiary. About the time the clover harvest begins, take from A all its frames except one, brushing the bees back into the hive, and replacing the combs with frames filled with foundation.

The one comb left is to guard against the chance of starvation if two or three bad days should occur, and it will be one of the outside ones containing honey. These frames are put into another hive that we will call C. We have now a hive containing brood but no bees, and the vacancy in it is filled with a frame of comb or foundation. It is then placed on the stand of B, and B is removed to a new stand. If this change be made late in the day, there will be no bees to take care of the brood in C, and during the night many will be chilled and starve. So we must operate in the forenoon, and throughout the day there will be a constant return of B's field bees to cover the brood in C. Perhaps the very best time would be to watch when B's bees were having a play spell. At that time many of the *younger* bees are out, and would join C and young bees are better for starting queen-cells. However, even field bees can do housework if forced to it, and there will be a host of young bees hatching out every day. So if it is not convenient for you to operate at the time of a play spell, take some time in the neighborhood of 9 or 10 o'clock.

You ought now to have three good colonies instead of two. A ought to be better than a natural swarm, for it is much the same as a natural swarm, only it has all the bees of a colony instead of part. B will become strong again very shortly, and may do good work in supers if it does not swarm later on. C has all the flying force that was in B, and although it will be about three weeks before the young queen gets to laying, there will be during all of that three weeks the same lot of young bees hatching out daily that would have hatched out in A if no change had been made. The drawback comes to C after the three weeks are up, for there will then come another three weeks during which not a bee will hatch. This can be helped if at the time of making the change a mature queen-cell or a queen be given to C.

About the time the young queen is expected to begin laying, if C rears its own queen, it is well to give C a frame containing young brood. This seems to act as a stimulus, and at the same time helps you to determine whether the colony is all right as to its queen. If the queen has been lost, you will find queen-cells started, and you may allow these to go on to completion unless you can help them with a young queen or mature queen-cell.

Under ordinary circumstances you need not expect as much surplus from these three colonies as you would have had from the two *if* neither of the two had swarmed. As a compensation you have the additional colony. If, however, there should be an excellent fall flow, the three combined may give more than the two would have given.

A modification of this plan is, instead of taking all the brood from

one hive, to take one or two frames each from several hives, and when you have a hive filled with them to set it in place of a strong colony.

INCREASE BY NUCLEI.

A favorite plan with many is to commence with a nucleus and let it build up into a full colony, giving it help if needed.

Here is one way: From a strong colony, A, take two frames of brood and bees, putting them in an empty hive B, and set this in place of A, putting A in a new place. Three days later, do the same thing again, taking two frames of brood to make C, setting C in place of A. Three days later still, repeat the operation, making D, and setting it in place of A. Three days later still, let A and B change places. You now have three good nuclei, and A will be again strong enough so that from time to time you may take from it a frame of brood to strengthen one or other of the nuclei. Each nucleus can rear its own queen from the start, but you will get on faster and have better queens if you give each nucleus a good sealed queen-cell started in a full colony.

Here is another way, in which you will not need to look elsewhere for queen-cells: From a strong colony of good stock, take two frames of brood with adhering bees and the queen, and put them in a new hive in a new place. Eight or nine days later, divide the old colony up into nuclei, setting each nucleus in a new place, allowing one of the nuclei to take the place that has been occupied by the queen for the last nine days, and setting the hive with the queen back on the old stand. Of course, you will see that each nucleus has two or more good queen-cells in positions where there is no danger of their being chilled, as heretofore advised.

After reading up the subject under the head of nuclei, you will be ready to form several nuclei by means that you think best. Suppose you have five of these nuclei started. As already instructed, you will have a queen reared in each of them. A week or so after a nucleus is started give it a frame of brood without reference to the condition of its queen. Then a week or ten days later give it another frame. By this time it has a laying queen, if you gave it a mature queen-cell in the first place, and when you give it the frame of brood it will be a gain to give some bees with the brood if they can be spared. It has now four frames of brood, and if it is not too late in the season it ought to be able to build up without further help.

Very likely you may ask where you are to get frames of brood to give to these nuclei. One way is to take all the brood from a colony and divide it among the nuclei. That is not the best way. Take away only enough to leave at least four frames of brood in each hive from which you draw. If that will not give you as many frames

of brood as you would like for your nuclei, then be satisfied to make a smaller number of nuclei. Set it down as a matter of very bad policy to make your full colonies too weak by drawing brood from them. Always leave four or five frames of brood in the hive.

Your greatest danger will be in starting too many nuclei. It is so easy to make them that you will be likely to have a whole lot without enough to help to build them up, and then winter will catch you with a lot of weaklings that will be gone by Christmas. You will get on faster in the long run if you go slower at the start.

When you find you will not need to give any more help to the two, three or more nuclei you have started, because they already have four or more frames of brood each, then you may start more nuclei. When the first formed nuclei have five or more frames of brood, then you may draw brood from these to start fresh nuclei or to strengthen those already formed. Thus you may keep on, always keeping an eye out for the close of the season, being sure to get all built up before the season becomes too late. You may count pretty certainly that you will try to increase too much, and will have some weaklings to your sorrow, and it may do little good to warn you, but please remember that you did not do so without warning.

You have been told to start a nucleus with two frames of brood. Three would be better, and you will always keep in mind the possibility that many of the bees will be likely to return where they were taken from, so besides the bees that adhere to the combs taken it may be well to take a few bees from the other combs. Two or three frames of brood have been mentioned, but it is always well to have also a comb of honey to start a nucleus. There is something about it that keeps them in better heart, aside from the fact that without a frame of honey the bees may starve. When a nucleus is first started, it is wise to allow a very small entrance, for robbers are likely to be on the lookout, and any newly placed nucleus receives from them special attention. On that account it is never safe to form nuclei at any time when honey is not coming in pretty freely, for there is always less danger of robbing when bees find work in the field.

RENDERING BEESWAX.

If you work for extracted honey, it will be an easy matter to get from the cappings a nice cake of beeswax. A good deal of beeswax may also be got by saving all scraps of comb, and sometimes whole combs may be melted up because crooked or containing too much drone comb.

It is somewhat difficult to get all the wax out of old combs, because the cocoons act like so many sponges, taking up the melted

wax. To avoid this, at least in part, old combs should be soaked in water until the cocoons are saturated, and then they will not take up the wax. If they can be frozen after being thus soaked with water, they can then be broken up into small pieces. Without this breaking up, the cocoons, even if saturated with water, will act as little cups to hold the wax.

The cheapest wax extractor you can buy will cost you two or three dollars, and if you have no great quantity of wax to extract you can get along very well with nothing but a square tin pan split open at one corner. Put your bits of comb to be melted into the pan, and put the pan in the oven of a cook-stove. Let the open end of the pan project out of the oven, of course leaving the oven-door open, and put a stone or something under the end of the pan that is in the oven, so that the melted wax will run out, and set a dish under the dripping corner to catch the wax, having a little water in the bottom of the dish. Avoid having hot wax in iron, as it blackens the wax. Do not spoil wax by overheating.

When you have rendered the wax out of the combs, there will be more or less impurities in it. If the wax is melted and allowed a long time in cooling, that will give the impurities a chance to settle, when they can be scraped off the bottom of the cake. Here is a good way: In the evening, when there is no longer so hot a fire that there is danger of making the wax boil over, put the dish of wax in the cook-stove oven and close the door. Let it stay there all night, but be sure to take it out in the morning before kindling the fire.

To clean wax from utensils, heat until the wax is very soft, and then wipe off with old newspapers. Benzine will dissolve it so it can be wiped off with a cloth.

ROBBING.

Bees are symbols of industry, and if there is any time when they especially deserve credit for industry and perserverance it is when they get thoroughly started at robbing. Do not believe the foolish assertion that there is no danger that a colony of your bees will not rob another in the same apiary. The matter of ownership does not concern them, and they will be more likely to attack a colony near by than one at a distance.

As in many other cases, prevention is better than cure. Be careful to do nothing to start robbing. A comb of honey or brood left standing exposed for a short time when little or nothing is to be gathered in the fields may start the whole apiary into a furore. When honey is coming in freely, there is comparatively little danger. Perhaps the worst time is at the close of a harvest, when the bees are suddenly stopped from gathering in the field, and make every

effort to find a place where they can get something for nothing. If at any time when honey is not coming in you have opened a hive, and find the robbers pouncing in, you may do well to close up for the time being. No use to try to drive the robbers away with smoke. You may for the time being drive them away, but you also drive away the bees of the hive as well, and make them unfit to defend their stores.

Weak colonies and those that do not have laying queens are objects of particular interest to robbers. Try to keep all colonies strong, and if you must have a weak colony in a time of scarcity, see that its entrance is only large enough for one bee to pass at a time. If in the spring you find a weak queenless colony being robbed, it is often the best plan to let the robbers entirely alone and let them finish up the job. If you take the hive away, the robbers will pitch fiercely into the nearest hive, but if you let the hive stand, the robbers will work at it until nothing is left, and gradually give it up. If there is much honey in the hive, you may take most of it away, but leave the hive unmoved for the robbers to work at. Sometimes the robbed bees will turn in with the robbers and help them.

But it is not always desirable to allow the robbers to have their own way. Sometimes some carelessness on the part of the bee-keeper may start robbing in the strongest and best colony in the yard, and every effort should be made to stop them. Pile hay or straw at the entrance and at the sides of the hive, piling it as high as the top of the hive or higher, and sprinkle it thoroughly with water. The robbers do not like the wet, and they do not like to work their way through such a difficult passage, while the bees of the hive will force their way through. Keep everything thoroughly wet until the robbers stop, which may not be until sundown. Italian bees defend themselves against robbers better than black bees.

WATER FOR BEES.

Bees use a great amount of water. Nectar, as usually gathered from the flowers, contains a large proportion of water, and while the bees are busy on this they have no need of water besides. But in a very dry time, or when no nectar is coming in they will often be found returning to the hive with water alone in their honey-sacs. In spring time, before the flowers yield nectar, many bees may be seen along the margins of small streams, busily sipping up water from the sand and pebbles to carry to their hives. The weather being raw and cool, accompanied perhaps by high winds, these journeys for water are perilous, and thousands of bees thus sacrifice their lives, especially if they must travel a great distance. Some think it worth while to make the work less dangerous for the bees

by furnishing a supply of water near by in some sheltered spot. One good way is to furnish water in the same way that syrup is fed. (See Crock-and-plate feeder, page 30). Another way is to take a large crock and fill it nearly full with sticks of firewood set endwise (all the better if the wood is rotten), and then fill up with water. If you simply give them a crock of water, they will drown in it.

If you get them started to getting water at a particular place in the spring, they will continue to go there all through the season, unless you let the water dry up for a day or so. One advantage of having a regular watering place for the bees is that you thereby avoid the annoyance of having them gather toward the end of summer at the pump or at the watering trough. Horses dislike bees very much at their watering troughs, and are sometimes stung by the drowning bees.

ENEMIES OF BEES.

Aside from the ignorant and careless bee-keeper, no enemy of the bees has been considered worse than the bee-moth or wax-worm. Since the introduction of the Italian bee, however, this enemy is little to be dreaded so long as combs are in the care of the bees, provided the bees are as much as half Italian blood. Indeed, even with black bees there is no occasion for anxiety if the colonies are strong. If a colony is so weak that it cannot cover more than one-half its combs, then the moth has a fair chance to lay its eggs without hindrance in the unoccupied combs, and the heat from the bees is just the thing for the comfortable growth of the little worms that hatch from the eggs. If the bees are black it may not be long until all the unoccupied combs are consumed, leaving in their place a lot of webs, cocoons, and fat worms an inch or so long. If, however, the bees are Italian, they will scout around over the unoccupied combs, and pick off the little worms before they become of sufficient size to do any serious damage.

Very often the worms have more blame laid to their door than fairly belongs to them. A man says: "I had a rousing good colony that sent out three swarms, and the first thing I knew the worms got at it, killed the bees and finished up the whole business. That's the most discouraging thing about bees; the worms kill so many of them every year." And he thinks he is telling the truth when he says the worms or the moth killed his strong colony; the truth being, however, that it was greatly weakened by sending out three swarms, and failing to rear a laying queen, the discouraged bees died off, and left the worms in full possession of the combs. It would be just as reasonable for him to say that maggots had killed a horse if he should find one filled with them a few weeks after it had been shot.

As prevention is better than cure, it will be easy to understand

that the main thing is to avoid giving encouragement to the breeding of worms in combs. Do not have combs or pieces of comb lying about as breeding places. Especially do not have a weak colony or nucleus of black bees in a hive that is filled with combs. Keep Italian bees, and follow the golden rule, "Keep all colonies strong," and you can snap your fingers at moth and worm. Something more as to the treatment of worms will be found under the heading, "Care of combs."

Ants are somewhat serious enemies in the south, but as far north as this the most that can be said of them is that they are troublesome. Perhaps they are more troublesome to the bee-keeper than to the bees. Some bee-keepers have quilts over the brood-frames, although now-a-days there is nothing generally but an air space of one-quarter of an inch between the top bars and the cover. The quilt furnishes a delightful place for the ants to make their nest, the bees not being able to get at them, but furnishing abundant heat for the ants. When the bee-keeper opens the hive, the ants run over his hands and arms, biting him, and they run in among the bees, stirring them up to anger. Sometimes the bees take a curious revenge by seizing the ants, sailing off in the air with them, and dropping them so far from home that they will not find their way back. Aside from the annoyance, the ants do little or no harm, and make their nests in the hive for the sake of the warmth. Have hives so constructed that there is no place in them where a bee cannot get as well as an ant, and the bees will keep the ants away.

Mice commit depredations winter and summer. In winter they make havoc in hives occupied by colonies, whether the colonies are strong or weak. They eat the honey, which is the smallest part of the trouble, for there is greater loss from the combs destroyed by them, and they may even eat the bees. In summer they like to make their nests in hives filled with combs but without bees, and gnaw the combs badly. Such hives should be closed mouse-tight.

So long as bees are active, there is no danger that mice will trouble a colony. When the bees become semi-dormant with the cold, then the mice seize their opportunity. The bee-keeper should head them off by closing the hive against them in time. It will not do to close the entrance against the bees, either in cellar or outdoors, so a good way is to close it with wire cloth of coarse mesh, say three meshes to the inch. Wire nails may answer if the right wire cloth cannot be had. Drive them so they will stand a fourth of an inch apart, and the mice will be excluded while the bees have free passage.

Spiders should not be allowed to have webs near the entrance to catch bees.

Skunks sometimes scratch on the alighting board at night, gobbling the bees as they come out. Stir Rough on Rats or some other poison

in an egg and place at the hive entrance. This repeated two or three nights has been said to put an end to the trouble.

Birds have been accused of eating bees, but they are innocent, with the exception of king-birds, bee-martins and possibly a few other insectivorous birds. But these last generally do enough good to compensate. If king-birds appear too troublesome, they may be persuaded to stay away by using the shot-gun argument.

DISEASES OF BEES.

Diarrhoea, or dysentery, is the disease that the bee-keeper most frequently meets among bees. It comes in cold weather when bees cannot fly, and a flight is a cure. Some, indeed, contend that it is not a disease at all, but a mere overloaded condition of the large intestines. Certain it is that when bees fly freely, if it be a disease, it can not continue. Bees are cleanly creatures, and like to fly a distance from the hive to empty themselves, but when they do not have this opportunity for a long time their bowels become so distended that they are obliged to empty themselves, and the front of the hive will be spotted by the dark brown excrement, and in severe cases the top bars and combs will be badly soiled. If still no opportunity comes for a flight, the bees will daub themselves and finally die in a filthy mass.

Some of the things that help to bring on diarrhoea may be mentioned. Cold, long continued, is a prime factor, from which it may be understood that a strong colony in a warm hive will be much safer than a weak colony in an open hive or one too large for it. But do not make the mistake of thinking that you may make a colony safe by closely plugging all the cracks and the entrance as well. Plugging the cracks is all right, but the entrance must be left open sufficiently for ventilation or the case may be aggravated. The food eaten by the bees has its influence. Well-ripened honey sealed over will not fill up the bees as will thin, watery stuff unsealed. Honey-dew is often of a character that will bring on diarrhoea in a short time. In some cases it may pay to take away the combs of honey-dew and replace with good clover or linden honey, or with sugar syrup. If comb honey is produced, there is less danger from honey-dew, for the bees generally have a good store of clover honey in the brood-combs. But if the honey be extracted, and especially if the bee-keeper is so unwise as to extract all the early honey from the brood-combs, then the bees may have nothing left to depend on but a bad quality of honey-dew. Cider from cider mills is bad. So is sorghum syrup, and burnt honey, candy, or sugar is about as sure death as winter food.

When a colony outdoors is affected with diarrhoea, about the most you can do is to let it alone and long for a day warm enough for

the bees to fly. In the cellar it is more likely there is something wrong that may be righted. If the ventilation of the cellar is bad, see to that. The temperature may be at fault. If above 45 degrees, if that is the temperature at which you have found the bees most nearly dormant, then cool it down. Less easy it is to warm it if too cold, but that may be done in most cases. If you cannot make a fire in the cellar, take down hot stones or jugs or bottles of hot water *tightly corked.* Raising the temperature when it is too cold will at least prevent the disease from being as bad as it otherwise would be, and it has even been thought that heating the cellar for a few hours to a temperature of 60 degrees or more acts a little in the nature of a cure. It seems natural to suppose that when a warm day comes, say in February, it would be the part of wisdom to take out of the cellar a colony affected with diarrhoea, and then return it after it has had a flight. In actual practice, however, this does not work well. Let the bees stay in the cellar until they can be taken out for good; but if a colony is badly affected it may be well to take it out a little earlier than it would otherwise be taken out. In any case do not take it out unless the day is warm enough for a flight.

Not so common as diarrhoea, but greatly more to be feared is the dread scourge, *foul brood.* So bad, indeed, is it that if you have only two or three colonies, and all have foul brood, you may about as well burn up all and go out of the business, for at least a time. Whole apiaries of fifty or a hundred colonies have been swept away by it as with a besom of destruction. The disease is highly contagious, and is caused by the presence of a microbe, *bacillus alvei.* If these bacilli or their spores obtain entrance into a hive, the colony is doomed unless vigorous measures are taken. The mature bees are affected little, if at all. As the name *foul brood* indicates, it is the larvae that suffer. The disease most commonly makes its way into new territory by means of honey from a diseased colony. A single drop of honey from a foul-brood colony may carry the disease to a whole apiary. A frame of brood from a diseased colony given to a healthy one means another case of the disease. When a colony has the disease and the owner is ignorant as to its nature, the colony dies or becomes so weak as to be overcome by robbers, and the robbing bees carry the diseased honey to their own hives, thus spreading the disease in every direction. So, if a man has only one or two colonies, he may think it is not worth while to fuss with them and may leave them to their own course; but if he has any honor about him he will want to burn them up for the sake of his bee-keeping neighbors.

The symptoms of foul brood are thus given in Root's ABC of Bee Culture: "Some of the brood fails to hatch. Cappings here and

there are sunken and perforated at the center. On opening one of these cells there will be found a dead larva lying on one side of the cell, somewhat shrunken, and of a brown color, varying all the way from a light pale brown to a dark brown. In the more advanced stages the brown is of the color of a coffee-berry after being roasted. In the incipient stages the brown is the color of the coffee we drink, when greatly diluted with milk. But so far all these symptoms may be present as the result of chilled, overheated, starved or pickled brood. But to determine whether it is the real foul brood, run a toothpick into the dead larvae and then draw it slowly out. If the matured mass adheres to the end of the pick, about like spittle —stretches from one-half to one inch—and finally the fine thread breaks when the pick is drawn back, it is probably a case of foul brood. With all other forms of diseased brood, with perhaps the exception of black brood (which, at certain stages, ropes very slightly, but never more than one-eighth of an inch, and the matter of black brood has a jelly-like consistency), this ropiness does not appear, but with foul brood it invariably appears. Now, there is another symptom, and that is the odor, while not exactly foul, resembles greatly that of a cabinet-maker's glue pot, and when the disease is pretty well advanced in a hive, the odor will make itself manifest upon lifting the cover or quilt, even before exposing the brood. If other colonies are affected, and the disease spreads, it is unquestionably foul brood."

It would take much room to enumerate all the foul brood cures that have been offered as sure, only to be rejected after trial. No man living has probably had more experience with foul brood that Wm. McEvoy, foul-brood inspector for Ontario, Canada, and the following is the treatment by which he says he has cured hundreds if not thousands of cases:

"In the honey season, when the bees are gathering freely, remove the combs *in the evening*, and shake the bees into their own hives; give them frames with comb-foundation starters on and let them build comb for four days. The bees will make the starters into comb during the four days, and store the diseased honey in them which they took with them from the old comb. Then in the evening of the fourth day take out the new combs and give them comb-foundation to work out, and then the cure will be complete."

Too great care cannot be taken to avoid the introduction or spread of foul brood. After handling a diseased colony, hands and tools must be thoroughly cleansed before touching a healthy colony. It is never safe to feed honey to bees unless you know that it did not come from a diseased colony. There is no way that a diseased comb can be cleansed so as to be used again. It must be burned or buried beneath the possible reach of plough or spade. Opinion

is somewhat divided as to whether it is safe to use the hive itself. But all are agreed that frames and combs should be destroyed. If any apparently good honey is found in a diseased hive, it is not affected for table use, only there is the danger that if it is kept for the table the bees may, in some, way, get a taste of it. If water is added to it and it is kept at the boiling point not less than three hours, the honey may be fed to bees. Some would hardly be willing to take that risk. The wax may be rendered and used, providing it is done by a person so careful that no part of the combs or remains get within reach of bees.

Black brood is a disease due to the presence of *Bacillus milii*, modified perhaps, by *Bacillus thoracis.* It bears a resemblance to foul brood both in appearance and destructiveness, but can be distinguished by the fact that the dead larva instead of being glue-like, as in foul brood, is of a jelly-like consistency, and instead of the offensive smell of foul brood it has a peculiar sour-like smell. Instead of drawing out into strings of half an inch or an inch in length, it never strings out to an extent of more than one-eighth of an inch.

Black brood is a disease of only recent acquaintance, and it is not certain that the best treatment has yet been learned. Dr. Wm. R. Howard, an expert bacteriologist, has given much attention to this and kindred diseases, and gives the following treatment:

The best time to effect a cure is during a honey-flow. Adopting a modified McEvoy plan:

"Make your stocks strong by uniting; place them upon comb-foundation starters, and cage the queen. After five days remove the starters and make them into wax, and give full sheets of foundation—keeping the queen caged five days longer. This will give time for all infected mature bees to have disappeared before any brood is reared."

Pickled brood, due to *Aspergillus pollinis*, a specific fungus, is not nearly so much to be dreaded as foul or black brood, and can be distinguished by the fact that the dead larva is *watery*, instead of being like glue or jelly. As to its treatment, Dr. Howard gives the following in The American Bee Journal:

"I have recommended, with successful results, placing the bees on full sheets of foundation, confining them for three days (giving them plenty of water) in order to consume all of the infected material, that none of it might be deposited in the new combs to be covered with new pollen or honey. The disease is infectious, and may be carried by robbers having access to infected combs."

Bee paralysis, due, according to Cheshire, to *Bacillus Gatoni*, is a disease of the mature bee. An affected bee may be seen at the entrance with its abdomen swollen and its body black and shiny,

and at least in the advanced stages having a peculiar trembling movement. It seems inclined to leave the hive, and the well bees show an anxiety to have it leave by tugging at it much as they would at a dead bee.

No reliable cure has yet been found, much to the regret of some bee-keepers in the south who have lost heavily by it. Fortunately, it is not a very serious matter as far north as Pennsylvania, and the bee-keeper need pay no attention to it. A few bees in one or more colonies may be lost by it, and then it may disappear of its own accord. Of course, where many bees in a colony are affected by it, such a colony can not be expected to do very good work.

The beginner is sometimes alarmed at finding a condition that he supposes is due to disease. The larvae are sealed up before attaining the pupa state, but sometimes a row or a cluster of cells will be found unsealed when the young bees are near maturity. These *bare-headed bees*, however, seem as healthy as any, and need give no uneasiness. It is not agreed just what is the cause of the trouble, but some think the bees have been sealed over and then wax-worms have destroyed the cappings.

Another thing that is sometimes mistaken for disease is a little more serious, although not at all a disease. When working on milk-weed (Asclepias cornuti), masses of pollen become attached to the feet of a bee, so that it cannot use its feet to climb upon the combs, and is driven out by the other bees. Usually the number of such bees is not great, and it is possible that the amount of honey gathered from the plant may compensate for the loss.

CARE OF COMBS.

Almost any bee-keeper will sometimes have honey-combs that are for a time unoccupied by bees. If through no other cause, he may have colonies die in winter leaving combs empty or occupied by honey or pollen. Such combs are valuable property and will well repay the care required to preserve them. The three principal enemies of unoccupied combs are mold, mice and moths.

Combs kept in a damp, close cellar are likely to be affected by mold. They should not be kept generally in such a place, yet it can not be entirely prevented where bees are wintered in the cellar, for even if no colonies die it may happen that some of the outer combs unoccupied by bees will be covered with mold. Fortunately, the remedy is not difficult. Put a moldy comb next the brood-nest of a prosperous colony in the working season, and you will be surprised to find how soon they will clean it up so you will hardly recognize it as the same comb.

Mice must be kept away from combs by shutting them up in hives

or elsewhere so the mice cannot enter. But be careful that you do not pen the mice in with the combs.

The chief villain, however, is the wax-moth. If a colony dies in spring (and it is not in early winter, but in late winter and spring that colonies usually die) and the hive remains unnoticed on its summer stand, it is morally certain that before the summer is over you will find it containing a solid mass of webs and cocoons, with perhaps not a vestige of comb left. You may seal up the hive moth-tight before it is warm enough for a moth to fly, and the result will be the same, for the eggs of the moth by some means have been laid in the hive, notwithstanding the presence of the bees, in the previous fall. It is, howver, not an easy thing to make a hive moth-tight, for a moth will squeeze through a much smaller crack than a bee.

The right thing to do with a hive full of combs upon which a colony has died is to get the combs as soon as possible in the care of the bees. Especially if they are of Italian blood, the bees will make short work of clearing out the worms before they are large enough to do much harm. Perhaps it is putting it too strong to say these combs should be put in the care of bees as soon as possible, for there will be little danger to the combs until the weather has become warm and bees have been flying for some time, say about the time of apple bloom. Take the hive of unoccupied combs, clean out all the dead bees, and put under a hive occupied by a strong colony. If there should be any entrance directly from outside into the upper hive, close it up, so as to oblige the bees to pass through the lower hive in going in and out. Keep the entrance very small the first few days for fear of robbers. If, unfortunately, the hive containing the colony has a bottom nailed to the hive, it may be worth while to knock it off for the sake of protecting the combs. After the colony has had this lower hive in charge for about a week, so as to get it cleaned out and get used to it, you can give it a second hive of combs to care for, putting this second one between the first and the hive containing the colony, so the bees of the colony must pass through both of the hives with unoccupied combs.

If colonies have died in hives in the cellar, there will not be the same need of haste as to getting them in care of the bees. Indeed, it may not be a bad plan to take into the cellar hives whose bees have died on the summer stand, notwithstanding the danger of the combs becoming moldy. In the cellar the worms will hardly get a fair start until it is time the unoccupied combs will be needed to form swarms. It is well, however, to look at them occasionally to see that they are all right, for it is not difficult to see where the worms have run their silken galleries. The question is often asked whether it will do to hive a swarm in a hive in which a colony has died. Unless such a hive is exceedingly filthy, the bees will promptly clean it up, and be saved much labor in building new combs.

It is well to know that freezing destroys both worms and eggs. So a hive of combs that has been left outdoors all winter is in no danger of worms until well along in warm weather, when moths have had time to mature and lay eggs in the combs. If such combs are hung up in an airy place with a space of an inch between them, they will almost surely be safe from worms throughout the summer, and indeed worms *may* not trouble them all summer if left in the hive in their usual position.

If for any reason it is desired to kill worms in combs, sulphur or brimstone is the usual resort. A very little of the fumes of burning sulphur will finish the worms when they are quite small, but when full grown it takes a very heavy dose, so it is well to pick out the larger ones by hand. Take a wire nail and pick open the comb at one end of the silken gallery for half an inch, then commence at the other end and tear it open the whole length. This will drive the worm along till it comes out of the hole you first made, when you can take comfort in ending its existence by what means may seem best.

Fill a pan or kettle partly full of ashes and set into it a smaller vessel of iron. In this put the sulphur and throw on it a shovelful of live coals or a red-hot iron. This must be in an empty hive or some way so it can be enclosed, the hive of combs quickly set over it, and the whole closed so the fumes cannot escape. Now look out, or you will burn up the whole business and, perhaps, the house besides. To keep the heat from setting fire to the combs placed over, put a piece of old sheet-iron (perhaps a piece of old stove-pipe) directly over the burning sulphur.

It must be remembered that burning sulphur destroys only the worms, not the eggs. So it may be necessary to treat the combs a week or two later, when any remaining eggs have hatched. But there is a drug that of late has been used that is said to destroy eggs and all. It is bisulphide of carbon. Put a little of the liquid in a saucer, set it in an empty hive over the combs, then close up tight so as to retain the fumes. But remember that this is a very explosive article, and if the flame of a candle should touch the fumes there might be a terrific explosion.

Combs of honey for table use are not likely to be troubled with worms, but with black bees, especially if the combs are left too long on the hive, there may be some trouble. The dose of sulphur for these may be lighter than for brood combs, and if too heavy a dose is given the white comb will have a greenish color. That, however, does not hurt it for eating.

When extracting-combs are extracted for the last time in the season, it is the practice of most bee-keepers to allow the bees to lick them dry. A hive full of such combs may be placed over a colony, but a surer way is to set the hive at some distance from the apiary and let the bees have free play at it.

UNFINISHED SECTIONS.

At the close of the honey harvest it will always be the case that more or less of the sections will be unfinished, the number varying greatly in different years. It will happen some years that the season will be so poor that none will be finished. Even in the best of years there will be a considerable portion left unfinished, varying all the way from those the bees have not started at all up to those that are filled with honey but have a few cells unsealed.

Those that have not been worked at all by the bees, having no honey at all in them, may be put away until the next year, when they can be used. Be very careful, however, that you do not make the mistake of leaving such sections too long on the hives. When the harvest is over they should come off at once, for the bees will only daub bee-glue upon them, and sometimes to such an extent that they will not accept them the following year. Indeed, some make a practice of taking off all sections at the close of the clover and linden harvest, so as to have none of the later and darker honey in them, and so as to avoid the bee-glue that will be put on them while the bees have nothing to do between the early and late harvests. If a fall flow comes, sections can be again put on, or extracting-combs.

Sections that are not entirely finished will, of course, do for the table, and if to be sold, must be sold at a lower price. Any that are less than half filled with honey should be fed to the bees. If you set out a super of such sections where the bees can get at them, they will promptly carry out the honey, but will be so eager in squabbling over it that they will tear down the tender comb so as to ruin it. Extracting-combs are not in the same danger unless very new. To avoid having the sections ruined for future use, cover them up so as to leave a passage for only one bee at a time to get at them. Better set them five rods or more away from the apiary.

These sections thus cleaned out by the bees will be valuable for use the next year, and one or more of them put in each super that is first put on the hives will start the bees promptly at work. If they are not cleaned out, the particles of honey remaining will candy and affect the new honey that is put in them the next season.

MOVING BEES.

As has been explained, bees mark their location, and when they return from a foraging expedition they find their place rather than their hive. If you turn a hive around, so as to make the entrance at the back instead of the front, it will trouble the bees very much. They will light in clusters where they think the entrance ought to be, and it will be some time before they find the entrance. If you

move the hive a foot to one side, they will hesitate and reconnoitre carefully before entering. If hive A stands three inches or more south of B, and if A be moved to the north side of B, whether it be a few inches or feet, the field bees belonging to A will return to B, because B stands nearer the right *place*. (It is true that a change in the looks of their hive will confuse them a little, but they go by place rather than looks.) But if no other hive is in the yard, and A be moved several feet or several yards, the bees will find it without much difficulty, because it is the only hive.

If a hive be moved a short distance early in the spring, at a time when the bees have not had a flight for a week or more, there will be little trouble about the bees staying by their hive. After the bees have been flying for a few days in succession in the spring, a removal of a few feet or rods would be followed by the loss of many bees that would go back to their old location, but a removal of half a mile would work very well. But in the middle of the harvest, a colony must be moved a mile or more to make it safe.

It will be seen that if a colony is to be moved a mile or more, there will be no trouble about losing bees if the removal is made at any time of the year, and if a colony is moved at any time during the winter or early spring, it does not matter about the distance it is moved. By taking certain precautions, however, a colony may be moved any distance, great or small, without regard to the time of year. Sometimes, we want to move them a short distance at a time of year when they are flying daily, and then we must take some precaution or we shall lose all the field bees from the hive and have them return to the old location. One way is to move them to some place, perhaps two miles distant, and return them two weeks later, when we can place them wherever we like in the yard or on the farm. While that is a sure way, it is not often a very convenient way. Some report good success by putting a board in front of the entrance after they have been moved. Then, instead of flying straight out from the entrance, as they have been accustomed to do, they bump their noses against the board at the entrance, which disconcerts them so much that they stop to examine the place, and thus take their bearings anew. As an aid it is well to change as much as possible the old location so it will not look like home. If a big bundle of straw is put in place of the hive on the old location it will help. Another plan may be more generally successful. Before moving the bees, close the entrance in some way that will allow a little air to enter, perhaps stuffing grass into it. Close the entrance thus in the evening, after the bees have stopped flying, so that all that belong to the hive may be in. You may move the colony in the evening after shutting it up, or any time before opening it the next day. Open it sometime in the forenoon between 9 and 12 o'clock. If the

bees are quiet, pound on the hive until you stir them up to making quite a noise; then let them out. There is just a possibility that if the weather is very hot and the colony very strong, the bees might smother unless the entrance be closed with wire cloth, so as to allow of ventilation.

If bees are to be hauled some distance, care must be taken in freezing weather not to break the combs by rough handling, for they are then brittle with the cold. They may be hauled nicely on a sled if the sleighing is good. If hauled in hot weather, the danger is that the combs may be melted down with the heat, or that the bees will smother. Abundant ventilation must be allowed, and abundant ventilation means a great deal in hot weather. Wire cloth over the entire top of the hive will be none too much. Of course the bees must all be fastened in the hive. If bees must be moved in hot weather, it is better to move them at night, because cooler. In any case, the bees must be fastened in the hive after flight has ceased in the evening. If the frames are fixed-distance as most of the latest frames are, they are always ready for moving. If, however, the hive contains loose hanging frames, then there is some danger that the frames may slide in their places and make trouble unless they are fastened in place. This may be done by nailing into each end of each top bar a wire nail, leaving the head up far enough so that it can easily be drawn out. Or, little sticks may be pushed down between the end bars of the frames so as to keep them in place.

A box hive may be turned upside down in moving.

PLANTING FOR HONEY.

Almost surely the farmer who becomes interested in bees will, sooner or later, begin to consider the matter of devoting some ground to the cultivation of plants that will yield honey, and the likelihood is that without any knowledge on the subject he will think that he can plant enough on a fraction of an acre to give plenty of occupation to a colony of bees. The erroneousness of such a view will be seen when it is considered, that taking the State at large, each colony has 50 to 100 acres of ground to work upon. It is now pretty thoroughly understood that there is no plant that can be profitably cultivated for honey alone, at least upon land that can be utilized for any ordinary crop. It is a good plan, however, to encourage the growth of honey plants upon waste places. Perhaps no other plant is so good for this purpose as sweet clover. It is one of the best yielder of honey, and will grow on almost any kind of soil. A few seeds scattered along the wayside will grow and increase, and it is better to have the ground occupied thus than by some utterly useless weed. In some places there is a prejudice

against it, a prejudice without sufficient ground, for it may remain along the roadside for years and not encroach upon cultivated ground. Moreover, it is a biennial, dying root and branch the second year, and if cut so as to prevent its going to seed it is easily killed out. Where cattle are allowed to run on the roadside, and have become used to it, they will keep it eaten down so it will not become unsightly. But they must first learn to eat it.

Although there is no plant that can be profitably cultivated in good fields for honey alone, the farmer will do well to have an eye to crops worth planting aside from the honey they yield, which will at the same time give a harvest for the bees. But it must be remembered that to be of any service there must be a considerable quantity of any given honey plant. The growth of lindens may be encouraged in preference to trees that yield no honey. As a shade tree along the roadside, the linden is fine. Gooseberries and raspberries are valuable honey plants. Buckwheat is so well known as to be hardly worth mentioning.

Of course there will always be more or less of the great standby, white clover, and it is well to try other clovers. It is claimed that there are strains of bees that do fair work on the second crop of red clover, with its shorter flower tubes. Some effort is being made to breed bees with tongues longer than the average, and if this is sucessful, we may yet save the tons of red clover honey that are going to waste.

Alsike clover is very valuable. One trouble is that it blooms at about the same time as white clover, when it is not much needed. If cut in June, just as it begins to blossom, it may be made to bloom later, and thus prolong the harvest.

Crimson clover is especially valuable because coming so early. If yours happens to be one of the localities where it is profitable as a forage crop, or rather where it succeeds well, you will have an additional inducement to cultivate it on account of its honey.

Sweet clover, or melilot, is a plant well worth your while to experiment with. In some places it is highly valued as a forage plant. It is a near relative to the much-vaunted alfalfa, and before the plants are in blossom it may trouble you to tell one from the other. While alfalfa yields tons upon tons of honey in the west, it has never been reported as a honey-yielder in the east, even in the few cases in which it has been successfully cultivated. But sweet clover will flourish anywhere, and upon no other honey plant can you more surely depend for a yearly yield of honey. Stock must learn to eat it, and so they must alfalfa. It has been reported that where the two grew side by side, cows would prefer the sweet clover. You may find that it will be easier to teach stock to eat dry sweet-clover hay than to teach them to eat it in the green state.

Sweet clover is of great value as a fertilizer. When it dies the second winter, as it always does, the long roots rotting away, leave the ground filled with larger and smaller holes. If turned under while green, it gives a dense mass of fertilizing material. It may be used to bring into fine tilth ground useless for almost any other purpose. It will grow in the toughest clay, where perhaps nothing else would grow, leaving the ground in better condition for something else.

Sweet clover does not bloom until the second year, but a crop of hay may be cut from it the first year. It blooms nearly as soon as white clover, and if cut just before coming into bloom it may be made to bloom after white clover is gone. Even without any attention its blooming period lasts after white clover is gone, and sometimes bees may be seen working on it after heavy frosts.

ARTIFICIAL POLLEN.

Generally, bees are able to get all the pollen they need, but sometimes there is a time in the spring when it is nice and warm but there is nothing from which the bees can gather honey or pollen. Pollen is just as necessary for bees as honey, and if there is none in the hive (although there generally is) and nothing to gather it from, no brood will be reared, no matter how strong the colony may be. You may, on such warm spring days, give the bees something as a substitute for pollen, especially if you see them so eager for it that they are working upon the sawdust at the woodpile. They will accept almost any kind of grain ground, chopped corn and oats being a favorite. Whatever ground feed you are giving your horses and cows may be given to the bees. Put in a shallow box, set it out in the open sun, and the bees will find it. Tip the box a little to one side, putting a stone under one side. When the bees have worked the feed down level, reverse the box so the other side will be higher, repeating this throughout the day. When they have worked out all the finer particles, feed the rest to the cows and horses. Even if the bees do not greatly need it, it is worth while to feed it for the sake of seeing them work at it in such a rollicking manner. As soon as they can get the real article, as from hazel, willow or soft maple, you will find your substitute deserted.

OUTDOOR VERSUS INDOOR WINTERING.

It may trouble you a little to decide whether you should winter your bees in the cellar or on the summer stands. It may be well to go by precedent. If you have always wintered successfully in a

certain way, by all means continue in that way. If you have had no previous experience, find out how others in your neighborhood have succeeded, and follow the example of the successful ones. It is not the severity of cold so much as its long continuance that is hard on bees. A short spell of 40 degrees below zero is not as bad as several months of 30 degrees above. If, in your locality, you are likely to have spells of continued severe weather so that the bees cannot fly for two or three months at a time, then the cellar may be the best place for you. If, on the other hand, the winters are somewhat open, a day coming every two or three weeks when bees can fly, even if they are sometimes confined a month or so, then they may be better off on their summer stands.

PREPARATION FOR WINTERING.

You *may* prepare bees for wintering in October, but it is very much better to begin earlier. Some say in August is the right time, and in some cases it may be. If all storing is over in August, and the bees are short of stores for winter, then it may be just as well to feed them in August. In any case it is better not to wait later than some time in September. Bees should have plenty of time to get their stores located to suit them and to have all sealed. If any colony is not strong enough to cover four frames, unite it with another. This uniting should not be left until late. If the bees are to be wintered outdoors, 20 to 30 pounds of honey will be needed, say 4 to 6 frames of sealed honey. For the cellar, 3 or 4 well-filled frames may do. Be sure to have enough. Some colonies may not consume half the amount indicated, but you do not know which colonies they are, and it will not be wasted if they have too much. Just as well have something left over so they can begin the sooner in the surplus apartment as to have them wait to fill up the brood-chamber with white-clover honey before they begin in the supers.

If colonies are lacking in stores, give frames of sealed honey if you have them. If you do not have them, give granulated sugar and water, equal parts, using a Miller feeder or the crock-and-plate plan. This kind of feeding is better than to give less water with the sugar, for it is more like the thin nectar the bees gather, and there are changes made in it by the bees which they cannot make so easily on the thicker syrup. But they must have plenty of time to evaporate and ripen this food, and if they cannot have it while warm weather yet lasts, say by the middle of September, then the thicker syrup should be given. If you should be so unfortunate as not to get them fed in time enough to allow them to seal the syrup, then use candy. (See Syrup and Candy, page 29.) Better take pains, however, not to be late about feeding. As an

extra inducement to this, it may be mentioned that the earlier feeding with the thinner material tends to make the queen lay, thus having a larger force of young bees to endure the winter and be ready for spring work.

For wintering outdoors, the entrance of the hive should not be more than three eighths of an inch by eight inches for strong colonies and less for weaker ones. To keep out mice, close the entrance with wire cloth having three meshes to the inch. This will allow the bees to pass, but not the mice. With so small an entrance there is danger of clogging, and this must be guarded against by cleaning out the entrance if it needs it. Some put under the hive a rim an inch or two deep with the entrance at the top of it, and with this there is much less danger of clogging. The hives should not be in a windy place, but sheltered especially from north and west wind. Let them face south or southeast, and put some kind of packing about the hives without closing the entrance, even if nothing more than corn stalks piled up against them. Some use the old-fashioned bee sheds of our grandfathers with good success. The success will be more sure if straw is packed behind and between the hives. Some put over each hive a box large enough to cover it and leave a space of three to six inches all around between the hive and box, packing this space with chaff, dry leaves, planer shavings or something of the kind. Of course the entrance must be kept clear.

One of the things that is bad in winter is too much moisture in the hive. The bees are constantly breathing out moisture, which settles on the cold walls like the moisture of the air on a pitcher of ice water on a hot day. This may form icicles directly over the bees, and when it melts it will fall upon the bees, to their serious injury. Provision may be made for the escape of this moisture elsewhere than at the entrance. Put burlap or some kind of cloth over the top bars with a corn cob under it, so the bees can cross from one frame to another, then cover with three to six inches of leaves, chaff or planer shavings, and put on the cover. This will allow the moisture to escape slowly upward.

OUTDOOR WINTER CARE.

Having provided in advance for the welfare of the bees by making sure that they have plenty of provisions and are warmly tucked up in their winter quarters, and having provided against intrusion of mice and disturbance from domestic animals, there is little to be done for the bees throughout the winter, unless it be to clean the dead bees out of the entrance and to guard against the combined effect of sun and snow.

When the ground is covered with soft snow and the sun shines

brightly, the bees will be enticed out by the brightness, dazzled and confused by the snow, and will fall into it never to rise again. If they have had a flight within two or three weeks it may be better for them to remain in the hives, and a board can be placed before the entrance so as not to shut out the air but to shut out the sun. If it is best to let the bees fly, tramp down the snow hard in front of the hives or sweep it away, or else cover the ground with ashes, straw or something to cover the snow.

Do not be alarmed if snow covers the hive, no matter how deep, but sometimes you must look out for it when a small amount falls and the entrance is closed with it, and then it thaws enough to become somewhat solid at the entrance and freezes in that condition. You must clear out the entrance to avoid smothering.

CELLAR WINTERING.

One of the difficult things about cellar wintering is to tell when to take the bees in. There can be no fixed date in the case. One year may be very different from another. Here is a safe rule to follow: At any time after November 10, when the day has been so warm that the bees have had a good flight, carry them into the cellar, if you know they will not be able to fly again for six weeks, but if you know they can fly on some fine day within two or three weeks, leave them out until then. But, alas, who can apply the rule, for who can tell what may be in the next three or six weeks? The best you can do, there must be some guessing in the case. If the bees fly November 10, you are pretty safe in guessing that it is not their last flight, but you would not be so safe in making the same guess November 30. It is better, however, to err on the safe side. Suppose you are in a pretty cold locality, and the bees have had a good flight November 15, and you put them in the cellar the next morning. Then a week later comes a nice, warm day for bees to fly, and you feel foolish and wish you had left them out a week longer. The next fall there comes again a good flight day November 15, but with your greater experience you are not to be caught this time; so you leave them out for the warm day to come a week later. But a week later the warm day does not come; on the contrary, it turns out to be one of those severe winters when the bees will not fly again until spring. About the first to the middle of December you give up hope of a warm day and put the bees in without it. After that you will be likely to make your mistakes on the safe side, and take the bees in too early rather than too late. That extra exposure of the bees for two weeks in weather constantly growing colder was harder on them than twice or three times as long in the warm cellar. It will do no great harm to put the bees in the cellar two or three weeks too soon, but it will do much harm to have them in that much too late.

Possibly you may say, "I think I know how to manage it; be sure to take them in early; then, if a warm day comes, take them out for a flight and take them back again." It would be hard to say why that is not a good plan, but actual practice shows that it does not work well and is not advisable.

Having decided that it is time for the bees to go into the cellar, put them in the evening after their flight, or within a day or two. If there is hard freezing, the hives may be frozen down so that when you crack them up it will stir up the bees badly. Crack them up twelve or twenty-four hours before carrying in, and put a nail under. The hives will be taken into the cellar with the covers on, just as they were on the summer stand. They need no ventilation above, providing they have big ventilation below. But box-hives may be turned upside down so as to have all upward ventilation. It will not make the bees dizzy to stand on their heads.

Unless your bottom boards are so deep as to leave one or two inches space under the bottom bars, it is as well not to carry them in the cellar. But if you do take them in, be sure that there is abundant ventilation below. The hives may be blocked up an inch or more. If you want to take up little room, set a row of hives with, perhaps, ten inches of space between them. Then set a row of hives without any bottom boards over these, each upper hive resting on two of the lower ones. That will leave an open space under each hive, and you may thus pile them up as high as the room will allow. They will take up still less room if your bottom boards are one or two inches (better two inches) deep, for then you can pile each hive directly over another and pack the piles closely together. You will generally find the bees very quiet the next day after having a flight, and if you are careful in handling them they will not be likely to fly out.

If it should happen to be warm for some days after they are in the cellar, leave doors and windows of cellar wide open every night. They may even be left open in day time if you find the bees do not fly out. After the bees are in the cellar, every bee that flies out of the hive is a dead bee, for it never finds its way back to the hive. Bees will find their way back if they crawl out upon the outside of the hive, and you need not be alarmed if sometimes quite a cluster hangs out. When the weather gets cold, whether it be the next day or three weeks later, keep all closed up. Whenever it seems too warm in the cellar, cool off a little at night. Put a thermometer in the cellar, and see at what temperature the bees are most quiet, and after that try to keep the temperature as near that point of quiet as you can. If the cellar is too warm the bees will stir about and be somewhat noisy. If it gets too cold they will make a sort of humming sound in trying to keep warm, and the colder it is the louder

the humming. There is a certain point at which they will be neither too cold nor too warm, but almost dormant. It will be somewhere about 45 degrees, but thermometers and cellars vary, and it is better for you to find out for yourself what is the right degree in your cellar with *your* thermometer.

If it should go down below 40 degrees for any length of time, it would be well to try to make it warmer. If you have no stove in the cellar, take down hot stones or jugs of hot water, *corked tight*. But do not use an oil-stove, a lamp, or anything of the kind without having it directly connected with some kind of a pipe or chimney to carry off the smoke or gases.

If mice are in the cellar, close the entrances of the hives by means of wire cloth having three meshes to the inch; this will keep out the mice but will allow the bees to pass. Do not confine the bees to the hive, for when bees are about to die from old age or other causes, it is their nature to leave the hive, and if confined, it is likely to make the other bees in the hive uneasy.

You need not be surprised to see bees come out of the hive to die throughout the winter, and if many colonies are in the cellar it will be necessary to sweep up the dead bees by the first of January, and monthly thereafter.

The quieter the bees are kept in the cellar the better, although it does no particular harm to go into the cellar as often as necessary to get the fruits and vegetables for the use of the family. These same fruits and vegetables should be kept carefully sorted over, and all that are decayed carried out, both for the health of the bees and that of the family.

DAMAGE DONE BY BEES.

Serious charges have been brought against bees, some of them ludicrous enough, such as bees eating young ducks. It is not to be denied that damage of a serious nature may come from the stings of bees. An animal tied close by their hives so that it cannot get away may be attacked and stung to death. An animal at large might be severely stung, but this is a rare occurrence. Some bee-keepers have kept farm stock in the same enclosure with bees summer after summer with no serious results. Occasionally a cow or a horse may get a sting, only to shake its head and run away to another part of the enclosure. It is hardly advisable to let sheep run among the hives, not for any harm to the sheep, but because sheep are worse than horses or cows about pushing hives off their stands. A Wisconsin farmer who kept bees was sued by his neighbor because his bees drove the neighbor's sheep from their white-clover pasture, so that the sheep became poor. Of course the suit

was lost, for one needs only a slight acquaintance with bees to know that they are utterly harmless when away from their hives.

A New York bee-keeper was sued because his bees ate the peaches on a neighbor's trees. The suing peach-grower had the pleasure of paying all the costs, for a bee was never known to bite through the skin of a sound peach. It may be remarked here in passing, that in both cases mentioned the sued bee-keeper had the benefit of help from the National Bee-Keepers' Association, of which any bee-keeper may be a member by paying $1.00. Its object is to look out for the interests of bee-keepers, chief among which is the prosecution of those who attempt to defraud the public by selling for honey some fraudulent preparation.

Frequently a grape-grower charges the bees with damaging his crop, and he seems to have a pretty clear case. There are the clusters of grapes covered with bees, and while he keeps his eyes fixed upon them each berry grows smaller and smaller until nothing is left but the skin. But each grape was first pierced by a wasp or bird, and intelligent fruit-growers say they prefer to have the pierced berries emptied by the bees, for they will rapidly sour and decay to the damage of the crop. At a time when no honey is being gathered, and when bees are fierce to get something from any source, take a cluster of grapes and prick half the berries with a pin and lay the cluster in front of a hive. The bees will promptly proceed to clean out the berries that were pierced, but not a sound berry will ever be in the least injured.

Cider mills and sorghum mills are troubled by bees, but the chief damage is to the bee-keeper, as thousand of bees are destroyed, and those that get safely home take with them that which may prove the ruin of the colony the following winter. If the law was appealed to, in consideration of the greater loss to the bee-keeper and the character of the bees as public benefactors in fertilizing the flowers, it is possible that the owner of the cider mill might be compelled to screen in his cider mill against the entrance of the bees.

There is one sort of damage done by bees which, although seldom occurring, it may be as well to know about so as to guard against it. When bees take their first cleansing flight in the spring, as on the day when they are brought out of the cellar, they will, when emptying themselves, spot everything within several rods from their hives. The good woman of the house should avoid having a washing on the line on that first day or she may have her temper so soured that it will take much honey to sweeten it.

Bees are not strict observers of the eighth commandment. In fact, when pasturage is lacking, they have no compunctions as to appropriating the stores of another colony, whether it be a foot or a mile away. When a colony is robbed, the owner of the

plundered bees, supposing or knowing that his neighbor's bees are the plunderers, is likely to feel, if he is not acquainted with the habits of bees, that he ought to be paid damages. In reality, the damages ought to go the other way. The morals of bees cannot be changed, and it is their nature to glean wherever they can in time of scarcity. The man who allows honey to be exposed so as to start robbing, or allows a colony to be weak and queenless so as not to be able to defend its stores, is culpable, and the man whose bees have been demoralized by temptations that have started them into dishonest habits from which they will not readily recover, is the injured party. It is not the business of any man to keep his bees from robbing, but it is the business of every man to keep his own bees from being robbed.

BEE LITERATURE.

In the limited compass of this Bulletin it is not possible to give all that should be known by one who desires to be fully informed upon the subject of bee-keeping. There are text-books upon bee-keeping that contain five or ten times as much as this pamphlet, leaving the subject so little exhausted that several periodicals devoted to bee culture have been published for years, each of them forming an annual volume containing a mass of bee-lore equal in volume to one of the text-books. For the benefit of those who desire to pursue the subject further, it may be well to name the leading books and papers.

Root's A B C of Bee Culture is not, as its name might indicate, a primer, but a very comprehensive cyclopedia of everything pertaining to bee culture; in fact no fuller work upon the subject is published in any language in the world. Its nearly 500 large pages are copiously illustrated by engravings, a few specimens of which may be seen in this Bulletin, having been borrowed from that work by the courtesy of its publishers.

Rev. L. L. Langstroth, the inventor of the movable-frame hive, wrote a work upon bee-keeping that is a classic. Written many years ago, it has lately been revised and brought up to the times by Chas. Dadant, a thoroughly practical bee-keeper. The book is called *The Hive and Honey Bee*.

The Bee Keepers' Guide: or, *Manual of the Apiary*, is written by Prof. A. J. Cook. Being a professor of entomology as well as a bee-keeper, he gives prominence to the anatomy and physiology of the bee, followed by a practical treatise on the different subjects pertaining to bee culture.

The following bee journals may be mentioned:

The American Bee Journal, 144 Erie st., Chicago; weekly, $1.00.

Gleanings in Bee Culture, Medina, O.; semi-monthly; $1.00.
The Bee-Keepers' Review, Flint, Mich.; monthly; $1.00.
The American Bee-Keeper, Falconer, N .Y.; monthly, 50 cents.
The Progressive Bee-Keeper, Higginsville, Mo.; monthly; 50 cents.

HONEY COOKING RECIPES.

In any case where honey is used in cooking in place of sugar, it should be remembered that the moisture in the honey makes it necessary that less liquid, as milk or water, should be used. It is especially convenient to have cake made with honey, as well as being more wholesome, for, instead of being good only for a short time while fresh, it may be kept for a long time, some of it for years, and if it becomes hard, close it up for a time in a bread-can or crock and it will regain its freshness.

Honey-Gems.—2 quarts flour, 3 tablespoonfuls melted lard, ¾ pint honey, ½ pint molasses, 4 heaping tablespoonsfuls brown sugar, 1½ level tablespoonsfuls soda, 1 level teaspoonful salt, ⅓ pint water, ½ teaspoonful extract vanilla.

Honey-Jumbles.—2 quarts flour, 3 tablespoonfuls melted lard, 1 pt. honey, ¼ pt. molasses, 1½ level tablespoonfuls soda, 1 level teaspoonful salt, ¼ pt. water, ½ teaspoonful vanilla.

These jumbles and the gems immediately preceding are from recipes used by bakeries and confectioneries on a large scale, one firm in Wisconsin alone using ten tons of honey annually in their manufacture.

Honey-Cake or Cookies without sugar or molasses.—2 cups honey, 1 cup butter, 4 eggs (mix well), 1 cup buttermilk (mix), 1 good quart flour, 1 level teaspoonful soda or saleratus. If it is too thin, stir in a little more flour. If too thin it will fall. It does not want to be as thin as sugar-cake. I use very thick honey. Be sure to use the same cup for measure. Mix the honey, butter and eggs well together. You can make it richer if you wish by using clabbered cream instead of buttermilk. Bake in a rather slow oven, as it burns very easily. To make the cookies, use a little more flour, so that they will roll out well without sticking to the board. Any kind of flavoring will do. I use ground orange peel, mixed soft. It makes a very nice gingerbread.

Howell Honey-Cake.—(It is a hard cake). Take 6 lbs. flour, 3 lbs. honey, 1½ lbs. sugar, 1½ lbs. butter, 6 eggs, ½ oz. saleratus; ginger to your taste. Directions for mixing.—Have the flour in a pan or tray. Pack a cavity in the center. Beat the honey and yolks of eggs together well. Beat the butter and sugar to cream, and put into the cavity in the flour; then add the honey and yolks of the eggs. Mix

well with the hand, adding a little at a time, during the mixing, the 1 oz. saleratus dissolved in boiling water until it is all in. Add the ginger, and finally add the whites of the 6 eggs, well beaten. Mix well with the hand to a smooth dough. Divide the dough into 7 equal parts, and roll out like ginger-bread. Bake in ordinary square pans made for pies, from 10x11 in. After putting into the pans, mark off the top in $\frac{1}{2}$-inch strips with something sharp. Bake an hour in a moderate oven. Be careful not to burn, but bake well. Dissolve sugar to glaze over top of cake. To keep the cake, stand on end in an oak tub, tin can or stone crock—crock is best. Stand the cards up so the flat sides will not touch each other. Cover tight. Keep in a cool dry place. Don't use until three months old at least. The cake improves with age, and will keep as long as you let it. I find any cake sweetened with honey does not dry out like sugar or molasses cake, and age improves or develops the honey flavor.

Aikin's Honey-Cookies.—1 teacupful extracted honey, 1 pint sour cream, scant teaspoonful soda, flavoring if desired, flour to make a soft dough.

Soft Honey-Cake.—1 cup butter, 2 cups honey, 2 eggs, 1 cup sour milk, 2 teaspoonfuls soda, 1 teaspoonful ginger, 1 teaspoonful cinnamon, 4 cups flour.

Ginger Honey-Cake.—1 cup honey, $\frac{1}{2}$ cup butter, or drippings, 1 tablespoonful boiled cider, in half a cup of hot water (or $\frac{1}{2}$ cup sour milk will do instead). Warm these ingredients together, and then add 1 tablespoonful ginger and 1 teaspoonful soda sifted in with flour enough to make a soft batter. Bake in a flat pan.

Fowls' Honey Fruit-Cake.—$\frac{1}{2}$ cup butter, $\frac{3}{4}$ cup honey, $\frac{1}{3}$ cup apple jelly or boiled cider, 2 eggs well beaten, 1 teaspoonful soda, 1 teaspoonful each of cinnamon, cloves and nutmeg, 1 teacupful each of raisins and dried currants. Warm the butter, honey and apple jelly slightly, add the beaten eggs, then the soda dissolved in a little warm water; add spices and flour enough to make a stiff batter, then stir in the fruit and bake in a slow oven. Keep in a covered jar several weeks before using.

Muth's Honey-Cakes.—1 gallon honey (dark honey is best), 15 eggs, 3 lbs. sugar (a little more honey in its place may be better), $1\frac{1}{2}$ oz. baking soda, 2 oz. ammonia, 2 lbs. almonds, chopped up, 2 lbs. citron, 4 oz. cinnamon, 2 oz. cloves, 2 oz. mace, 18 lbs. flour. Let the honey come almost to a boil; then let it cool off, and add the other ingredients. Cut out and bake. The cakes are to be frosted afterward with sugar and white of eggs.

Fowls' Honey Layer-Cake.—$\frac{2}{3}$ cup butter, 1 cup honey, 3 eggs beaten, $\frac{1}{2}$ cup milk. Cream the honey and butter together, and add the eggs and milk. Then add 2 cups flour containing $1\frac{1}{2}$ teaspoonfuls baking powder previously stirred in. Then stir in flour to make

a stiff batter. Bake in jelly tins. When the cakes are cold, take finely flavored candied honey, and after creaming them, spread between layers.

Fowls' Honey-Cookies.—3 teaspoonfuls soda dissolved in 2 cups warm honey, 1 cup shortening containing salt, 2 teaspoonfuls ginger, 1 cup hot water, flour sufficient to roll.

Honey Nut-Cakes.—8 cups sugar, 2 cups honey, 4 cups milk or water, 1 lb. almonds, 1 lb. English walnuts, 3 cents' worth each of candied lemon and orange peel, 5 cents' worth citron (the last three cut fine), 2 large tablespoonfuls soda, 2 teaspoonfuls cinnamon, 2 teaspoonfuls ground cloves. Put the milk, sugar and honey on the stove, to boil 15 minutes; skim off the scum, and take from the stove. Put in the nuts, spices and candied fruit. Stir in as much flour as can be done with a spoon. Set away to cool, then mix in the soda (don't make the dough too stiff). Cover up and let stand over night, then work in flour enough to make a stiff dough. Bake when you get ready. It is well to let it stand a few days, as it will not stick so badly. Roll out a little thicker than a common cookie; cut in any shape you like.

This recipe originated in Germany, is old and tried, and the cake will keep a year or more.

Honey Drop-Cakes.—1 cup honey, ½ cup sugar, ½ cup butter or lard, ½ cup sour milk, 1 egg, ½ tablespoonful soda, 4 cups sifted flour.

Honey Short-Cake.—3 cups flour, 2 teaspoonfuls baking powder, 1 teaspoonful salt, ½ cup shortening, 1½ cups sweet milk. Roll quickly, and bake in a hot oven. When done, split the cake and spread the lower half thinly with butter, and the upper half with ½ pound of the best flavored honey. (Candied honey is preferred. If too hard to spread well it should be slightly warmed or creamed with a knife.) Let it stand a few minutes, and the honey will melt gradually and the flavor will permeate all through the cake. To be eaten with milk.

Honey Tea-Cake.—1 cup honey, ½ cup sour cream, 2 eggs, ½ cup butter, 2 cups flour, scant ½ teaspoonful soda, 1 tablespoonful cream of tartar. Bake thirty minutes in a moderate oven.

Honey Ginger-Snaps.—1 pint honey, ¾ lb. butter, 2 teaspoonfuls ginger. Boil together a few minutes, and when nearly cold put in flour until it is stiff. Roll out thin, and bake quickly.

Honey Fruit-Cake.—1½ cups honey, ⅔ cup butter, ½ cup sweet milk, 2 eggs well beaten, 3 cups flour, 2 teaspoonfuls baking powder, 2 cups raisins, 1 teaspoonful each of cloves and cinnamon.

Honey Pop-Corn Balls.—Take 1 pt. extracted honey, put it into an iron frying-pan and boil until very thick, then stir in freshly popped corn, and when cold mold into balls.

Honey Caramels.—1 cup extracted honey of best flavor, 1 cup granulated sugar, 3 tablespoonfuls sweet cream or milk. Boil to "soft crack," or until it hardens when dropped into cold water, but

not too brittle—just so it will form into a soft ball when taken in the fingers. Pour into a greased dish, stirring in a teaspoonful extract of vanilla just before taking off. Let it be one-half or three-fourths of an inch deep in the dish, and as it cools cut into squares and wrap each square in paraffin paper, such as grocers wrap butter in. To make chocolate caramels, add to the foregoing 1 tablespoonful melted chocolate, just before taking off the stove, stirring it in well. For chocolate caramels it is not so important that the honey be of best quality.

Honey Apple-Butter.—1 gallon good cooking apples, 1 quart honey, 1 quart honey vinegar, 1 heaping teaspoonful ground cinnamon. Cook several hours, stirring often to prevent burning. If the vinegar is very strong, use part water.

Honey and Tar Cough Cure.—Put 1 tablespoonful liquid tar into a shallow tin dish and place it in boiling water until the tar is hot. To this add a pint of extracted honey and stir well for half an hour, adding to it a level teaspoonful pulverized borax. Keep well corked in a bottle. Dose, teaspoonful every one, two or three hours, according to severity of cough.

Summer Honey Drink.—1 spoonful fruit juice and 1 spoonful honey in ½ glass water; stir in as much soda as will lie on a silver dime, and then stir in half as much tartaric acid, and drink at once.

ROAD MAKING FROM THE ENGINEER'S STAND-POINT.

BY HON. A. W. CAMPBELL, *Deputy Minister of Public Works, Ontario, Canada.*
Delivered before the International Good Roads Congress, Buffalo, Sept. 16, 1901.

Mr Chairman and Gentlemen: I am sure that I am very glad to have another opportunity of addressing the good roads people of the United States. This is the third time, and I can assure you it has always been a very great pleasure and delight to me to avail myself of these opportunites and to listen to the vast amount of most valuable information afforded by many of your experts at these meetings.

We very often, in meetings of this kind, see fit to aim at solving the larger parts of the problem first, rather than taking up the smaller parts, and the parts which, after all, are of the greatest importance. The roads of our country are bad; the roads of the United States, from what I have seen of them, appear to be equally bad, and there is a good reason for this agitation. Roads are the one class of public works which I think on this continent has been most severely neglected, and very largely because we have always looked upon it as being a question of such commonplace importance that the business man, the man of knowledge and executive ability, always fought shy of it. The result is that we have to-day no organization. As Professor Holmes has said, we have no plans, we have no simple specifications. The work of road building in our country previous to the agitation, as no doubt is the case in a great many of your States, was being done without plans or specifications, without reason or design. But, as he has said, the people allow the cold machinery of taxation to take from their pockets each year many millions of dollars, which is turned over to be expended by men who have never given the question of road making the slightest thought from a scientific standpoint. The better classes have always been too busily engaged with other and more important questions, and the result is we have never really taken the subject of road making into serious business consideration.

The first thing to do is to try and solve the problem of how best to build a road. How should a road be built? If I were to ask you now that simple question, I possibly would get fifty different replies from the people in this audience. If a man undertakes the

building of an ordinary pig pen, he will take a piece of paper and sketch out a plan; he will consider the question of materials, and roughly estimate the cost; but in the matter of road making, involving the expenditure of millions of days of labor and millions of dollars of cash, the work is done without the slightest plans or specifications. Each municipality, under its system of labor, selects so many path masters at the beginning of each year, and those men simply receive instructions to go on and use their best judgment as to how the work shall be done, to get as much work as possible done, and have it done in the best possible way. The result is that in average townships there are some 75 path masters, and just 75 different plans of road building, and each year these men are again exchanged for others, so that each year, under the labor-tax system, plans are changed. One man who professes to know all about it will say: "I believe in making a narrow road, and grading it 12 feet wide." The next supervisor will say: "You don't know anything about the business, it should be 16 feet wide." The next one makes it 20, the next 25, 30 or 40 feet. One man says it should be built flat on the surface, and another says it should be crowned just enough to shed the water. The third man says: "I believe in sloping her up," and he slopes it so that it is almost impossible for teams to turn out. The following year other men are appointed with other ideas, who tear down the work that has been built before them, and this we call, in these enlightened days, a modern system of road building.

We talk about convict labor in the making of roads; but it occurs to me in passing over some of these roads that convict labor has been employed in the supervision of the work rather than doing it.

To build good roads we must reduce this matter to a simple proposition. I am an engineer by profession, but as a civil engineer I do not profess to be a road maker. My knowledge of road building comes most largely from the actual experience which I have had in building roads. When I started out to get my first experience and to build a road I thought I knew vastly more of the subject than I do to-day, after nearly fifteen years of actual experience. The trouble is that we all employ too much engineering knowledge and profess too much scientific knowledge of this problem. It is the simplest possible problem, but how we do complicate it! The average road supervisor makes the people believe that whatever he says must be done, even if the road be destroyed. The testing of stone and similar questions are important, but they will be solved by the trained and experienced road maker when he comes in contact with the work. We talk of bringing foreign material into our State and of dealing with the railroads in this matter. These are all local problems, which must be considered from the local standpoint pure

and simple. We talk of cost and we ask what it will cost to build a mile of macadamized road. That depends entirely on the character of the material you have to deal with, and the length of haul of material, and largely on the requirements of that particular road. It may be necessary for you to macadamize the road from ditch to ditch in order to accommodate the traffic in that particular locality, in which case possibly 30 feet of roadway would have to be macadamized, while on another road only a single track would be necessary, and 15 or 16 feet of well-placed macadam would be as serviceable as the 30 feet on the other road. We can, however, reduce this to a question of cost per square yard, using a certain limit of haul as a basis for our calculations. But these are questions, I say, which are of a local nature.

In the first place we should ask ourselves: "How should a road be built; what are the fundamental principles of construction underlying it?" Then let us answer that. Let us reduce the matter to as simple a basis as possible, lay down our plans for building roads so as to preserve uniformity in their construction and to bring about some decent results for the expenditure that is being made. We are talking about State aid and larger appropriations for road building, but my idea is, and it has been my experience, that we have already had control of too much money, and too much labor has been expended. The first problem to be solved, is to lay down simple plans for handling and expending in a proper manner the money which is being expended on the roads, and when we have completed our organizations and plans, to ask the State's indulgence for a greater amount to be expended in order to bring about results in the least possible time. I agree with Professor Holmes that system, plans, united effort, concentrated expenditure, and systematic and skilled supervision are what are really required, rather than a greater amount of money, in order to bring about good roads.

Let us lay down the simplest possible plans; let each township, each county, take up the question in the first place and say what leading arteries in their territory should be made and maintained as county roads, and let those roads be planned by the county council, made by the county council, and maintained by them for the use of the whole county. Then let the municipal council or the township council plan the remainder of the roads in their municipality, and say how they shall be laid and maintained; and the material to be used in these roads, and the cost of these roads, and so forth, should be in proportion to the amount of traffic which they are likely to bear.

In the first place, a plan should be prepared showing what roads are in each township; then these should be classified according to

their importance. About one-third of the roads in a township are leading roads, used by the whole community. They should be made of a better grade and macadamized to a greater width than others; they should be made 24 feet wide between the ditches, graded to that extent, and macadamized or graveled to a width of 16 feet. Then there is another class of roads, constituting about one-third of the whole, which are used by neighborhoods and lead into the main roads; these should be made 26 feet wide and macadamized to a width of 12 feet. The remainder of the roads are simply lateral roads, used by a few people in reaching the other roads, and they should be put in good shape by draining and grading, as ordinary earth roads, and will for some years to come meet the requirements of traffic very well. When the roads have been classified in that way plans and specifications should be prepared for their construction.

There are just three principles underlying this whole question of road making. The first is drainage, the second is drainage, and the third is drainage. [Applause.] Drain the foundations. It is just as useless to attempt to build a road on a weak foundation as to erect a building or any other structure upon a weak or wet foundation. Drain the foundations. Do this by using tiles—a row of tiles beneath the frost line on the upper side of a road where it is being built on the side of a hill. If it is being built through flat land, then place them beneath the frost line on each side of the grade. One gentleman asked to-day whether it would not be preferable to place the drain in the centre. We have tried that plan, but my experience has proven that it is vastly better to place single tiles of smaller dimensions on each side of the road than to place one large drain in the center. Where the road passes over a flat piece of land the soakage during the wet season is from the adjoining fields into the roadway; the water runs in and fluctuates, rises and falls with the wetness or dryness of the season. If the tile drain is placed in the centre of the road the water must pass under the road in order to reach the tiling, and the result is that the roadway will attract moisture rather than be free from it. If the tile is placed on each side of the grading outside of the road metaling, then these tile drains cut off this soakage water and always protect and keep the road dry.

The next thing is to grade the road and prepare it for receiving the gravel and stone. The grading, of course, should be done as uniformaly as possible and according to a fixed plan. Our plan is to grade the road by giving it a fall of an inch to a foot from the centre of the road to the edge of the ditch, and making that as uniform as possible. The centre of a road 24 feet wide would consequently be 12 inches higher than the edge of the road by the side ditch. This should be done as perfectly as possible. The ditches then should be placed on each side, thus making the drainage as effectual as pos-

sible. Side gutters should be made sufficient to carry the water away at all times, and every water-course should be taken advantage of as an outlet, so as to dispose of that water in as small quantites as possible and in the quickest possible time.

The next matter is to place culverts. This is a most important matter, and was referred to by Professor Holmes as being one of the important questions that should be considered. If you were to solve that problem alone to-day, you would have done for the people a very great service, because in some of our municipalities we have roads the cost of maintaining which has been most materially reduced by simply changing the old system of building and maintaining timber culverts and using something of a more substantial nature. There are hundred of thousands of these small sluices in every municipality that must be maintained in order to carry the water in the natural water-courses, and every experienced municipal official knows very well that this is one of the greatest items of expenditure, and when we hear that so many thousand dollars each year are devoted to the keeping up of roads, it might be learned that nearly 75 per cent. of the expenditure consists of the cost of maintaining these perishable culverts. In the early history of the country, when timber was plentiful, all we had to do was to cut down a tree and make a cheap culvert, but now that material is much more scarce in most districts. We buy lumber at $12, $16 or $18 a thousand to use for repairs on culverts. It is then subjected to the most severe test that timber can be given; it is placed underground, exposed to frequent changes of wet and dry, and its life is only about five years. This item runs into a very large amount of money each year. Seventeen years ago we abandoned that system and undertook the building of concrete pipes for renewing these culverts. Our people at first regarded that as a copy of the plans of the ancient Romans in road building, and as altogether too expensive for this new country. But it seems that a simple construction of molds can be produced for about $5, and the material can be made with a simple mixture of cement and gravel by the use of unskilled labor, and the whole matter can be most economically carried out. When those culverts are once made and properly laid, they are practically indestructible. As I say, we began this seventeen years ago, and since then have renewed every sluice in the municipality, and to-day we are not expending one solitary cent on the maintenance of culverts. These pipes may be used up to 3 feet in diameter, and if you require greater capacity you can lay two pipes side by side, leaving a space of about a foot of earth between them; and where a greater capacity of water way is required we simply put in a concrete arch.

This is a simple construction. Templets are made just as a mason makes a templet in a window, and about four are placed in a culvert;

rough boards are used for the false arch, and gravel and cement are mixed together and simply put in. The width for a 5-inch culvert would be about 12 inches at the bottom, sloping up to about 5 inches at the top, then the false work can be taken away; it is left until it sets and there is a culvert which will not require any future repairs.

We use the best material for covering or surfacing the road that is available in the municipality. Very often this material is not of the very hardest nature, but it is cheaper to use that material and to spend a little more in annual maintenance than it would be to freight material for a long distance, especially where the freight rates are very high. A road should be constructed of the very best material and after that it should be maintained and never allowed to get out of repair. It is one thing to build a road and another thing to provide for its proper maintenance, but that should be part of your plan. Where field stones and quarry rock are to be found we use crushing machines similar to those on the construction trains. These crushers prepare the material in four different sizes, ranging from two and one-half inches down to stone dust. Usually on the principal roads we put down a layer of the coarsest stone in the bottom, the next size on top of that, the finer on top of that, and surface or finish it with the fine material. On much-traveled roads we make the depth ten inches in the centre and seven on the side. That is made up of seven inches of the coarest stone in the bottom, two inches in the next course, and one in the next, and the stone dust is placed over that. This is thoroughly and completely rolled in order to get a proper surface. Each layer is rolled and the final layer is rolled until the whole is thoroughly packed. It should be sprinkled with a watering cart in connection with the rolling.

This is a simple plan of construction. The width of our roads varies according to the requirements, our narrowest roads usually having ten feet of macadam. Where material can be obtained within a mile and a half of the work, these roads cost us thirty-five cents per square yard. Then a regular system is adopted to maintain them. That matter should be placed in the hands of regular and competent men. In order to bring about all this work, prepare this material, and make this road, it is highly necessary that you should provide machinery and the latest and most modern instruments for doing the work. It is just as useless and foolish to attempt to build a good road by using the old plow, scraper, etc., the implements of twenty-five years ago, as it would be to attempt to erect a structure like this magnificent building by using a hammer and a bucksaw. It matters not what a man's knowledge of road building may be, without good tools he can not do good work. You may place me in charge of some of the roads where the old system prevails, and tell

me to follow the practice that has been followed in the past, and I could produce no better results than they.

We must change our method and system. The system of labor taxes was suitable for pioneer days. It has performed its work. Many people to-day fear this agitation, because they have the greatest sympathy for the old pioneer methods and do not wish anything should be said that would in any way cast reflection on that system. That system did a work which I do not suppose could have been performed by any other method, but its day of usefulness has passed away. Those who are most strongly defending its methods are its greatest enemies, because they are asking it to perform a work that it never was designed to do, and in that way they are doing it a great injustice. We must do away completely with that old method. Let us lay down the system by which the council will have control of the road, appoint trained superintendents to look after the work, and equip ourselves with the best modern instruments. Have these placed in the hands of regular officials, with a skilled and experienced superintendent at the head; then lay down the plans and commence to work in a small way. Use to the best advantage the money and the labor you are now expending, and when that is done, and you show the people good samples of first-class work, they will readily appropriate money from their own funds; and the State legislatures will come to your assistance and grant all the aid that is required in bringing about an improvement in the condition of these roads.

System, plan and united effort are what are required, and until these are accomplished little can be done.

My business as an engineer and as a road expert is (I am in the employ of the Government for the Province of Ontario) to go about among the people in the townships, villages and towns, to meet with them in the schoolhouses and town halls, and talk over the question of making the roads in their particular municipality; to take a plan of their township and discuss the question with them, and try to arrive at a system for them to work upon; discuss with the road builders there the system of statute labor and what should take its place, and help them modify its plans and go along in the right manner; to get them then to set aside $100 or $200 or $300 for the purpose of collecting stones and providing themselves with the proper kind of machinery. Then it is my business to go there and take charge of the work of building a piece of road, as far as that material will go; have the people come there and see and watch the work from beginning to end; and have this done in each of the municipalities. I found that this work was absolutely necessary; you had to go among the people, show them what could be done right in their own neighborhoods, convince them that a good road is better than

a bad road, that they ought to build good roads rather than bad ones. When this was done we found that a lively agitation was created among the different municipalities; the legislature was quick then to respond to the voice of the people, and last year a bill championed by Mr. Patullo was put through the legislature granting $1,000,000 to aid municipalities in the bettering of the roads along the lines they themselves had created.

In carrying on my work I went to New Orleans to attend the convention of the good roads association, and there I saw the good roads train and the work which was being done by it. I immediately returned and suggested to the executive of our association that we should adopt some such plan. The manufacturers immediately offered to supply the machinery, the railroads said they would carry the implements free from one part of the country to the other, and the municipalities said they would furnish stone at places convenient for the work to be done, and the result is that from the 1st of June we have been carrying on a work of practical construction. We go to the place where the material is prepared, crush the stone, grade the road, build these concrete culverts where they can be seen by the people, take one man from a township and train him in the work so he can do it after we have gone; we utilize the material that is there. We do not try to show the people a piece of superficial road and then get out, but the practice is to commence the work and carry it on until the material is exhausted, and as a general thing a mile of road is constructed in each municipality. At the next session of the legislature I expect a special appropriation will be made for operating six outfits of machinery in this way, and the municipalities will not be asked even to contribute the material, but sample roads will be built at Government expense, as free samples or object lessons to show the people how roads should be made.

We talk roads here, and I tell you how a road should be built. I frequently told the people how a road should be built before I knew how to build it myself. But what is the use of doing that, and what is the use of our going on railing at the people and trying to make them believe we know vastly more than they do about this subject? Let us try to undo, to unteach them something that they have been taught, and we will have accomplished a great deal and taken a step in the right direction.

I believe that if a premium were offered for it to-day and all the genius of man brought to bear and concentrated on the formation of one plan for the building of bad roads no more successful method could be framed than some of those ingenious inventions called road systems which have been employed in some of our municipalities. [Applause.] There were to be found the most unjust, the most unfair, the most incompetent, the most inefficient, and the most ex-

travagant systems that could ever be employed by the people for making and keeping up any public work, and particularly the important public work of building and maintaining our common roads.

Here is the greatest problem the people of this country have to solve in connection with the whole system of transportation. You are appropriating millions of money for building canals and railroads. On the wall is a placard which says that 95 per cent. of every material that passes over your canals and railroads must in the first instance pass over the primary roads. In connection with your canals you are doing an immense work; you are still appropriating money and making them more efficient. Your railroad corporations are expending huge fortunes in reducing grades and making their roads straight and smooth; steamboat companies are expending great sums in enlarging the capacity of their ships and increasing their speed. What does all that avail if you who are to be most benefited do not in the first place undertake some sensible system on a business basis for the improvement of the most important part of the whole system of transportation, namely, the building and maintaining in a wise manner of the common roads of the country?

REPORT OF THOMAS MEEHAN, BOTANIST, TO THE STATE BOARD OF AGRICULTURE.

Harrisburg, January 23, 1901.

The report of the Botanist the past year has been confined to answering inquiries by letter, as to the names of new weeds that have made their appearance in various localities, and for information as to their injurious character and methods for the prevention of their spread, and for their easy extirpation.

There has been no newcomer brought to his attention that is likely to be a serious menace to the agriculturist, though two very annoying species seem to be extending their boundaries considerably. These are the English wild lily (*Convolvulus arvensis*,) a member of the morning-glory family, and the horse nettle (*Solanum Carolinianum*,) a relative of the potato and the egg plant. Both of these increase by underground stolons or runners, and the smallest fragment of a broken root grows to be a new plant. A single hoeing or breaking up by the cultivator only serves to multiply the evil. If, however, these plants get a second hoeing before the disturbed roots have made mature leaves, they are usually totally destroyed.

It may be taken as an axiom that no plant can live over a single season, if not permitted to mature growing leaves. If, for instance, a field of corn be infested with these root-increasing plants, the working of the cultivator will destroy numbers, and a week or two afterwards the man with the hoe should follow to cut up the few that may still be inclined to grow. It is of course, interesting to have the names of the newcomers. It enables us to understand what we read about their behaviour and general character in other quarters, but in practice their destruction is easy without the knowledge of their names.

This practical solution may also be applied to cases of inquiry from fungus growths, specimens of which are accordingly sent for name amongst the troubles of fruit growing. Formerly it was believed that that these minute plants only grew on dead or diseased portions of fruits and plants, just as we know the blue mould appears on leather or bread. But it is now known that some of these cause disease. With this knowledge the grape grower places a paper bag over the bunch of grapes in an early stage of formation. This ex-

cludes the spores (the analogues of seeds in the higher plants), that cause the disease and the bunch is saved. For scientific purposes the names desired for these different fungus organisms, are of little use for those who ask for them. It is now well-known that copper solutions in the form of spraying is destructive of all this class of organic life, and the names of the species does not in the least help the fruit growers in the task of destruction.

Some curious questions have come to the botanist in regard to the appearance of plants in localities where the ground had not been disturbed for long periods, and in the belief that the seed had been in the ground for long periods, and was not newly introduced to the newly turned up earth. Though cultivators have long had the belief that the seeds had been for an indefinite time in the ground, men of science have not generally accepted this as an undoubted fact. During recent years, however, more exact knowledge has been obtained on the subject, and your botanist has had to answer the inquiries in the affirmative, that is to say there is no reason why the newly appearing plants may not be from seed that has been in the ground under conditions unfavorable for revelation for an indefinite period.

It is interesting to note that when once a question that seems difficult is clearly solved, the evidence every where seem so abundant as to excite wonder that there should ever have been any question raised. For instance, fruit seeds will not germinate unless at a temperature above 55 degrees. Nurserymen have to freeze them, that is keep them for a while in a low temperature before they will sprout. If kept dry till the warm weather comes they remain in the earth without growing till the year following. Cherry seeds under a tree will sprout before the frost is barely gone, but those not sown till the temperature is higher, do not sprout. Cherry seeds kept in a room at a temperature over 55 degrees will retain their power to grow for many years, starting at once when placed for a little time under a snow heap, other seeds will only sprout when over 55 degrees. Each kind has its own requirements, and in the absence of these the communicating power is indefinite.

It is pleasant to note the increasing interest in that department of botany that deals with plant life. The mere names of plants, the countries they come from, and their place in a system of classification as herbarium specimens are essential matter in the progress of the science, but studies connected with the behaviour of plants is of more value to the cultivators of the soil.

REPORT OF DR. BENJAMIN LEE, SANITARIAN, TO THE STATE BOARD OF AGRICULTURE.

Harrisburg, Pa., January 23, 1901.

What should be the function of the Sanitarian, to a State Board of Agriculture? What possible use can there be for such an official? Is he not an appendage as destitute of value, although not as dangerous, as is the human appendix to its possessor?

These questions presented themselves to the mind of the writer when he received the gratifying request from the Secretary of Agriculture to accept the position referred to. Somewhat in the dark as to his duties, therefore, but unable to resist the promptings of vanity, he laid the flattering unction to his soul and accepted the highly appreciated honor with whatever responsibilities it might involve, secretly trusting that the latter would be about commensurate with the salary attached to the position. To his surprise, however, he is suddenly called upon for an annual report. But how to report when he is not conscious of having performed any duties. Much admirable sanitary work in connection with the Board and the Department of Agriculture has been done, but by others. The report of the State Veterinarian and his able assistant in Bacteriology in the annual report of the Department of Agriculture for the year 1899 on "Tuberculosis of Cattle," is a monument of industry and a model of scientific research, and shows the authors to be sanitarians of first rank. Glanders, anthrax and rabies, three diseases communicable to human beings from domestic animals, have also been the subjects of careful study by these officials and much has been accomplished for their restriction. Such reports are calculated not only to do much good by disseminating information in our own State, but also to give the Department a high standing in the estimation of the agriculturists of other States and European countries. Much good work of a sanitary nature has also been accomplished in the detection and prevention of the adulteration of food products by the Food and Dairy Commissioner, a branch of sanitation, the value of which it is impossible to over-estimate.

When the State Board of Health was first established, more than fifteen years ago, the Board issued an address to the people of the State, indicating what its members considered to be the sanitary

necessities of the Commonwealth, and the relations, duties and responsibilities of the Board in view of these necessities. In the course of this address occurred the following suggestion:

"In an immense territory like our own, larger than that of most of the nations of Europe, with its great diversity of surface, its lofty mountain ranges, and its immense forests, wonderful opportunities exist for sanitary engineering on an immense scale, determining in what direction water-sheds shall be encouraged and in what diverted; to what extent private corporations are to be allowed to jeopardize the health of large sections of the country by obstructing natural water-courses, for the purpose of manufacture or navigation, and deciding how far certain forests act as natural barricades against devastating winds, and should, therefore, be left untouched by the axe in order to maintain a permanent average rainfall, and thus avert droughts, cyclones and floods."

Whether or not this presentation of the subject had a stimulating effect on the minds of those to whom it more particularly appealed, it was not very long thereafter that the question of forestry began to be seriously considered by leaders in agricultural science and by our legislators, with the well known result, not of assigning this subject to the State Board of Health, but of the establishment of the office of Forestry Commissioner, and the final incorporation of this office as a bureau of the Department of Agriculture. No more important sanitary work can be imagined than such judicious protection of forest areas as shall ensure an abundant supply of pure water for the use of our people for generations to come, while at the same time affording recreation for the lover of sport, a resting place for the weary and opportunity for recovery to the invalid. How well this is being done is shown by the reports of the present indefatigable and learned Forestry Commissioner. The address continues:

"The Board must also consider the relations of the country to the city as a purveyor. The supply of fresh vegetables and fruits, and pure milk and other dairy products to large communities of the utmost importance, and every effort will be made to require and secure it. The transportation of live stock for food needs to be very carefully watched and regulated, both that none but healthy, and therefore, wholesome meat may be exposed for sale, and that infectious and epidemic diseases may not be introduced among our native herds and flocks from other localities."

It is interesting and encouraging to glance over the pages of that address, already yellowing with time and note what great advances have already been made on all the lines of reform therein indicated.

An English physician and sanitarian travelling in our country about that time wrote as follows in one of their prominent Journals of "the conditions here as he saw them:"

"There is much good work done under a species of semi-authority and sufferance, and by volunteer exertion; but the plaint is the lack of a central authority

and administrative power to make sanitary supervision an effective reality. The water supply of a considerable portion of a great city is abominally polluted, but no sufficient authority is found to remedy it; there are numerous and deplorable nuisances, but no efficient inspectors; there are many factories and work-shops, but no laws to secure their hygienic condition or the physical well-being of those employed in them; there is evidence unmistakable of the sale of unwholesome and adulterated food, but it is nobody's business to meddle with it and protect the public."

Now let us take up these serious and absolutely irrefutable charges *seriatim* and see what has been accomplished towards the removing the stigma.

First. The State Board of Health now supplies the alleged want of a central sanitary authority.

Second. We have a law on our statute books forbidding the abominable pollution of the water supply of the great city referred to, and under this law many sources of such pollution have been entirely cut off.

Third. The State Board of Health now has an inspector in every county and deputy inspectors in many townships, through whose agency hundreds of nuisances are abated every year.

Fourth. We have a State Factory Inspector, with several deputies under him, and stringent laws for protecting the health of employees of both sexes and of all ages.

Fifth. We have inspectors of anthracite coal mines and inspectors of bituminous coal mines, with boards of examiners for each, and carefully drawn laws for the protection of the miners.

Sixth. We have a Dairy and Food Commissioner, with authority to prevent the sale of adulterated food and diseased meat.

Seventh. We have a State Veterinarian and State Live Stock Sanitary Board to check the spread of disease among food producing animals, and stringent laws have been enacted to prevent the introduction of diseased animals from outside the limits of the State. Thus so far as our Commonwealth is concerned every one of these criticisms have been recognized as just and met in a spirit of practical reform. It is safe to assert that no previous period of fifteen years in our history has seen such remarkable and substantial advances in measures for the protection of the life and health and increase of the comfort of our people in country, village and city.

But this has been a digression which will, I trust, be pardoned. We were wrestling with the question of the duties of a sanitarian to a Department which has already a number of trained sanitarians in its various bureaus, who are doing excellent work. May we not conceive these duties to be twofold:

First. The presentation of problems relating to the hygiene of the homes and occupation of those engaged in agricultural pursuits, with an attempt at their solution.

Second. The consideration of the relations of the agriculturist as a food producer to the public at large and the duties growing out of these relations.

Each of these lines of thought is capable of subdivision in several directions which it is believed may be followed with profit. Let us hope with interest as well.

During the few moments for which I shall claim your attention, allow me to take up one or two problems which belong to the first-class, and to begin with, that of "How to Banish Typhoid Fever from the Farm House." There is a prevalent impression that people who live in the country are always healthy. This is simply confounding what ought to be with what is. People who live in the pure country air, drink water which comes sparkling from the living spring and eat vegetables fresh from the garden and meats raised on the place, ought to be more free from disease than the denizens of the crowded city, shut up between brick walls, breathing an atmosphere filled with filthy dust and redolent of the sewer, drinking water in which a dozen towns have washed themselves and eating, heaven only knows what. But in point of fact one does not find it so; and it not infrequently happens that the resident of the city, seeking health and recreation during the summer in a farm house of a country village returns to his home to sicken of typhoid fever, the germs of which he has imbibed from some polluted well. For what is true in a general way is eminently true of this widely prevalent disease. Typhoid is conspicuously a disease of the farm house and the country village, as compared with the city.

The reason that we read of it oftener as occuring in the city, first, because there, careful statistics of mortality and of communicable diseases are kept, and secondly, because the actual number of cases occurring in an immense population is of course large and attract attention.

The State Veterinarian in his able report for 1899 states:

"The value of the work of the State Live Stock Sanitary Board has been somewhat restricted in some instances from the fact that it has not always been able to obtain early information of outbreaks of infectious diseases. The fact that no one was especially responsible for the rendering of a report, has sometimes led to failure to report outbreaks of which many were cognizant. This is merely an illustration of the truth expressed by the words "everybody's business is nobody's business." There has not been, in any instance with which I am familiar, a direct attempt to conceal the existence of infectious diseases, and many failures to report outbreaks may, no doubt, be accounted for by the supposition that people that knew of them expected them to be reported by some other person who in turn thought that another would do it."

If this is true with regard to outbreaks of contagious diseases among domestic animals, it is true to an even greater extent with regard to contagious diseases in human beings.

The absence of a proper system of State registration of vital statistics in this State, is at once a misfortune and a disgrace; a misfortune because it leaves us without any reliable means of knowing what the comparative mortality and prevalence of disease has been in different parts of the State in any one year, or in the whole State for successive years, and because it allows epidemics to get headway before they are reported to the central authority, and this leads to much avoidable suffering and loss of life; a disgrace because Pennsylvania is pointed at with the finger of scorn by sister States, as a laggard in the great march of civilization, for the lack of it.

Am I wrong in asserting that the condition is near akin to barbarism in which a human being, any one of you, for instance, men of high standing in your respective communities, if you do not happen to live within the limits of an incorporated borough or city, may, when his useful life has terminated, be put under the ground with no more legal or official recognition or record of the fact than if you were a dog? Is it any wonder that grave-yard insurance has flourished in Pennsylvania, when such laxity prevails? In New York, New Jersey, Ohio, Michigan, in fact in almost any other enlightened Commonwealth, it would be possible for the central health authority to present exact figures showing how many deaths take place from typhoid in a year, and what proportion of these take place in the country and what proportion in the city. As it is, I can only say that the number of instances in which the State Board of Health is appealed to for aid and advice in checking the spread of typhoid in the rural districts has convinced its members of the truth of the assertion just made. During the past fall, in one little village of 1,200 inhabitants, within the short space of two months, 167 cases of this disease occurred with 16 deaths. Little note was taken of this by the public at large because there were only 16 deaths. But suppose that the fever had prevailed in the city of Philadelphia to the same extent with the same mortality rate in proportion to population, and we should have had 180,351 cases and 16,249 deaths, the whole civilized world would have thrilled with horror at the thought of so terrible a scourge and Philadelphia would have been shunned as a veritable pest hole. If the fact be admitted that typhoid fever is a not infrequent visitant at the farm house and in the village, how shall we account for it? Simply by the other fact that with long use and increasing density of population, the wells, springs and streams of the entire State are becoming polluted, for in ninety-nine cases out of a hundred, typhoid can be traced to polluted water as its ultimate cause.

I know well that here I am treading upon dangerous ground and hazarding indignant criticism. No one tradition does the average farmer guard with greater jealousy than the reputation of

his well. He will as soon admit that the old family bible contains the germs of eternal damnation as that the old family well contains the germs of disease. His forefathers used its water for generations back, and what was good enough for them is good enough for him. Who can look upon that sparkling fluid and pronounce it impure? He fails to appreciate the fact that is is just this long line of ancestors who have preceded him in the homestead which had made the pollution of the well not only possible and probable, but almost an absolute certainty. At the risk of repeating what many of you may have already heard, allow me to read the following parody on the "Old Oaken Bucket" from the pen of a former president of the Board of Health of New York.

REVISED FROM A SANITARY POINT OF VIEW.

"With what anguish of mind I remember my childhood,
Recalled in the light of a knowledge since gained;
The malarious farm, the wet, fungus-grown wildwood,
The chills then contracted that since have remained;
The scum-covered duck pond, the pig-stye close by it,
The ditch where the sour-smelling house drainage fell;
The damp, shaded dwelling, the foul barnyard nigh it,—
But worse than all else was that terrible well,
And the old oaken bucket, the mold crusted bucket.
The moss-covered bucket that hung in the well.

"Just think of it! Moss on the vessel that lifted
The water I drank in the days called to mind,
Ere I knew that professors and scientists gifted
In the water of wells by analysis find,
The rotting wood-fibre, the oxide of iron,
The algae, the frogs of unusual size,
The water—impure as the verses of Byron—
Are things I remember with tears in my eyes.

"And to tell the sad truth—though I shudder to think it—
I considered that water uncommonly clear,
And often at noon when I went there to drink it,
I loved it as well as I now love my beer,
How ardent I seized it with hands that were grimy!
And quick to the mud-covered bottom it fell,
Then soon with its nitrates and nitrites, and slimy
With matter organic, it rose from the well.

"Oh! had I but realized, in time to avoid them,
The dangers that lurked in that pestilent draught,
I'd have tested for organic germs and destroyed them
With potass permanganate ere I had quaffed;
Or perchance I'd have boiled it and afterward strained it
Through filters of charcoal and gravel combined,
Or after distilling, condensing and regained it
In portable form, with its filth left behind.

"How little I knew of the dread typhoid fever
Which lurked in the water I ventured to drink!
But since I've become a devoted believer
In the teachings of science, I shudder to think.
And now, far removed from the scenes I'm describing,

The story of warning to others I tell.
As memory reverts to my youthful imbibing,
And I gag at the thought of that horrible well.
And the old oaken bucket, the fungus grown bucket.
In fact, the slop-bucket that hung in the well."

I would say then that the first step which every farmer should take to prevent typhoid from entering his home, is to have the water of his well or wells analyzed both chemically and bacteriologically. Should it prove to be impure, its use should be at once abandoned, no matter how healthy his family may have been in the past. If, on the other hand, it is found to be free from pollution, every possible precaution should be adopted to preserve its purity. It should be so walled up and cemented that no surface drainage can possibly reach it. All sinks, cesspools, dung heaps and pig pens should be removed at least two hundred and fifty feet from it, if on higher ground or on the same level. At least once a year it should be pumped dry and carefully examined to discover whether any polluting substances, such for instance as dead rats, mice or frogs could have gotten into it, and its walls should be scrubbed and whitewashed. If a case of typhoid actually occurs in a family, the edict should at once go forth that not a drop of the well water should be used for drinking, culinary or dairy purposes, which has not been boiled for at least ten minutes. No food which has been in the sick room should be eaten by other members of the family. No one should eat or drink in the sick room. Every one attending the patient should wash the hands most scrupulously before eating, and rinse the mouth with a disinfectant solution. All utensils used by the patient should be boiled. The discharges of the patient should be received in a strong disinfectant solution, stirred up thoroughly, and allowed to stand for half an hour, and then taken out and buried at least two hundred yards from the well or any water-course, in a situation where they will not be disturbed for at least two years. With these precautions there is every reason to hope that the disease will not spread beyond the first case. In visiting strange places, unless you have absolute assurances of the purity of the water, use only tea or coffee or cocoa.

A far less frequent source of the typhoid infection is the common house fly. Every effort should be made to keep these pests out of the kitchen, dining room, pantries and other places where food is exposed. Especially dangerous on this account, is the proximity

of a privy, a hog pen or a manure pile to a kitchen or dairy. A very serious outbreak of this disease at a summer boarding house during the past year was traced by the inspector of the State Board of Health to a privy close to the servants dining room, which was found to be swarming with flies which had easy access to the deposit of filth. With strict observance of the precautions above suggested, whatever conditions may prevail in cities which are too often compelled to drink diluted sewage, typhoid will soon disappear entirely from the home of the farmer.

The next problem which we may briefly consider and which I am sure will appeal to all the fathers present, is, "How may those scourges of childhood, diphtheria and scarlet fever, which have desolated so many homes be excluded from that of the farmer?" Here again we are met by the difficulties of determining where the hidden danger lurks. We only know that, as a rule, schools are centres from which infection spreads. On the other hand, the infection must of course in the first instance have been brought to the school. But whence? The last legislature, profoundly impressed with the importance of this subject, placed within the reach of all dwellers in rural districts the means of discovering. A law was enacted by that body authorizing the school board of any township to assume the functions of a board of health for the township, and requiring all physicians to report to such boards and to the school teachers every case of infectious disease occurring in their practice, immediately on their discovery. This information having been received, the law of 1895 makes the teacher's duty very plain. No child must be permitted to attend school from the house in which the contagious disease exists, without a certificate from a physician that thirty days have elapsed since the disinfection of the house. If every school board in the State had at once accepted the responsibilities which this law assigns them, hundred of lives of children might already have been saved. It should be your duty, gentlemen of the State Board of Agriculture, as you value the lives of your little ones, immediately on your return to your respective homes to remind your school directors of their duties in this vital matter. It is highly probable that the present legislature will so amend the law, of which I have been speaking, as to make it compulsory and not simply permissory; but in the meantime, why should innocent children be sacrificed to the ertness of public officials or the greed of parents who are determined to get all they can out of the State, even at the cost of spreading sickness, distress and death widecast among their neighbors.

The possibilities which we have been considering, are not mere theories. They rest on indisputable facts. Take these suggestions home with you, talk them over with your wives, discuss them with your neighbors, and do your part towards hastening the time when the voice of joy and health shall be heard in all your habitations.

A REPORT ON THE PROCEEDINGS OF THE BRITISH CONGRESS ON TUBERCULOSIS, HELD IN LONDON, JULY, 1901.

BY M. P. RAVENEL, M. D., *Delegate of the State Live Stock Sanitary Board.*

The British Congress on Tuberculosis was held in London, July 22 to 26, 1901. Almost every nation was represented not only by official appointees, but also by delegates from universities, societies, etc. The total registration reached the large number of 2,500, of whom more than 1,000 were actually present. Many notable scientific men were among the number.

The Congress was officially opened by the Duke of Cambridge as the representative of the King, on Monday afternoon, July 22, in St. James' Hall, and on the following morning the scientific meetings of the sections were begun. The plan was to have the meetings of the sections, four in number, in the mornings, and the general meetings attended by all the members of the various sections in the afternoons, these general meetings being addressed by men of distinction.

The sections were as follows:

1. State and Municipal. President, Rt. Hon. Sir Herbert Maxwell,

2. Medical (including Climatology and Sanatoria). President, Sir Richard Douglass Powell.

3. Pathology (including Bacteriology). President, Prof. G. Sims Woodhead.

4. Veterinary. Tuberculosis in Animals. President, Sir George Brown.

Many discussions of interest took place in each of these sections. In the veterinary section the value of tuberculin as a diagnostic agent was discussed at some length, the general opinion being highly favorable to it. Prof. Dewar, principal of the Royal Veterinary College, after considering other methods of diagnosis at some length, concludes that in tuberculin we have the most efficient, reliable and practical means of diagnosing tuberculosis. For its full and successful use it is necessary: (1) To have a reliable tuberculin prepared by a competent pathologist or pathological chemist; (2) to keep the herd to be tested quiet and undisturbed, and with no marked

change in food, pasturage and general surroundings for ten or fifteen days prior to the test; (3) to allow the veterinary surgeon perfect freedom and every facility in the application of the test. The normal temperature must be determined carefully by repeated observations, and the temperature following the injection must be compared with this. He believes that most animals giving a rise of two degrees Fahrenheit, and formerly considered doubtful ought to be regarded as tuberculous. Temperatures should be taken every two hours, and always on the 9th and 18th. When applied with every caution, at least 98 per cent. of the results will be definite and correct.

Prof. Nocard, of France, and Bang, of Denmark, both placed a very high valuation on the tuberculin test, the former regarding it as almost infallible when properly applied. Both, however, laid stress on the importance of clinical examination of the udder and uterus. Prof. Malm, of Norway, held that the test was infallible when care was taken. His conclusions are as follows:

REMARKS ON QUESTION ON CONTROL OF MILK SUPPLIES—DIVISION IV., STATE SECTION.

"1. The tuberculin employed for diagnosis should be a tuberculin produced on the same principles as that of Koch in 1890.

Its strength should be uniform, and it should be of such toxical strength as to kill with certainty six to eight weeks' old tuberculous guinea-pigs within eight hours in doses of 20-30 centigrammes subcutaneously.

2. Such a tuberculin produces unfailingly in tuberculous animals a febrile reaction of a distinct type. It is recommended that large doses should be given, even to young animals; there is no danger or inconvenience in always employing doses of a half to one gramme.

3. Tuberculin may at times also produce fever in non-tuberculous animals, but this fever is not typical and does not attain such a degree as in tuberculous cases.

4. If a typical tuberculous reaction appears in an apparently healthy animal, and, on dissection, nothing tuberculous is found, it is the fault of the dessector.

5. To determine with certainty whether reaction exists or not, it is necessary to take the temperature from the 6th to the 20th hour after injecting, hourly or at least every second hour.

6. The fact that tuberculin in a few isolated instances produces fever in non-tuberculous animals, is of no importance when the question is its usefulness as a means to eradicate tuberculosis, for in this respect it is decisive, as tuberculin invariably causes reaction in tuberculous animals.

7. The foregoing refers to animals treated for the first time. Most animals become more or less accustomed to the tuberculin, but this is uncertain and unreliable and can be overcome by the use of an increased dose or a tuberculin of greater toxical strength.

8. The practical combating of tuberculosis concerns administrative, economical and social spheres, and the answer must vary in different countries according to the prevalence of the disease and its extent, the system of farming and cattle-trade, and the pecuniary means available."

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Prof. Hutyra, of Hungary, had found in his experience that the tuberculin test gave only two per cent. of error, while Prof. McFadyean of Canada, placed it slightly lower than this. As the result of numerous investigations Prof. McFadyean concludes: "(1) Tuberculosis is esenially a contagious disease, and ought to be so classified and acknowledged by every country and State in the world. (2) It is insidious in character, and only in a few cases comparatively can it be diagnosed by physical examination; but in tuberculin we have a safe and reliable test by which even latent cases can be diagnosed. (3) That tuberculin is harmless. It does not produce abortion in pregnant cows, impotency in bulls, or in any way producing any injurious effects on animals tested by it."

Prof. Nocard, of France, read an important paper on

I. TUBERCULOSIS IN BOVINE ANIMALS: ITS DANGERS, ITS PROGRESS, ITS PROPHYLAXIS.

Conclusions:

"A.—Tuberculosis is one of the diseases of cattle which causes most loss to agriculture in all countries.

B.—Everywhere the disease is on the increase; everywhere it forms a menacing danger to public health as well as to public wealth.

C.—Infection being the only formidable cause of the increase of tuberculosis, there is need for the adoption of legal measures prescribing:

1. *The complete separation* of unhealthy from healthy animals;
2. The slaughtering, without delay, of those sick animals which show clinical signs of the disease, and especially of cows attacked with tuberculous mastitis;
3. The interdiction from selling other tuberculous animals for a destination other than the slaughter-house;
4. The pasteurization of all the sub-products of butter and cheese manufactories."

II. ON THE RISKS INVOLVED TO MAN FROM TUBERCULOUS ANIMALS (CO-OCCUPATION, MEAT, MILK).

Means of Guarding Against Them.

Conclusions:

"A.—The resemblance of tuberculosis in man and in mammals is no longer denied. Healthy cattle-sheds have been infected by lengthened occupation by consumptive cattle-men.

The converse is equally possible, at least theoretically. If it is not thought possible to prohibit cattle-men from sleeping in cattle-houses containing tuberculous cows, the least can be done is to warn the proprietors of the risks of this practice, and of the responsibility they may eventually incur. The nightly supervision of the suspected cow-shed can be effected by means of a glass building looking on the cattle-sheds, but having no direct communication with them.

B.—Meat obtained from tuberculous animals is rarely dangerous, and when it is dangerous it is only slightly so. The established regulations for the inspection of tuberculous meat would be sufficient to prevent even the shadow of danger, if such regulations were applied always and everywhere.

Unfortunately this is not the case.

The inspection of meat is organized only in a small number of large towns; it ought to be done everywhere, in villages as well as in towns, and it should be everywhere forbidden to sell meat not bearing the stamp showing that it has been declared to be wholesome by a competent inspector. This inspection could be easily carried out, and at little cost, on a similar plan to that adopted in Belgium for many years.

C.—The milk given by tuberculous cows is rarely dangerous, but when it is dangerous it is most often so in a very high degree; hence the necessity of submitting cow-houses to a periodical inspection when the milk yielded is destined for public consumption. Cows being really only dangerous when they have a tuberculous udder, the inspector's attention should be drawn to the state of the udder. Any cow showing clinical signs causing suspicion of the existence of a tuberculous mastitis, or of serious visceral tuberculosis ought to be isolated at once, pending the making of a diagnosis, this being easily and rapidly done by the present process; the milk should be boiled before being sold and consumed, even by the animals on the farm. The dairyman should be obliged to give information to the inspector as soon as he has ascertained the appearance of a mastitis of any sort. When the diagnosis is confirmed, the diseased cow should be rigorously excluded from giving milk, and should be slaughtered without the least delay. Lastly, the sub-products of butter or cheese manufactories (skimmed milk, butter-milk whey, etc.,) should not be delivered for the consumption of persons or animal until they have been pasteurized at the minimum temperature of 85 centigrade."

"III. Presentation of a goat attacked with experimental mastitis, and demonstration of the process of diagnosis called "harponnage."

"IV. Presentation of tables demonstrating the efficacy of the procedure recommended by the author for rendering cow-houses that are most seriously infected with tuberculosis, healthy, and to restore them to their original state without being obliged to buy a single animal from outside. Calves born of tuberculous cows remain healthy on the only condition of isolating them from their mothers as soon as they are born, and of feeding them by bottle with boiled milk."

The use of tuberculin for diagnosis as well as treatment in the human being was the subject of discussion in a joint meeting between the Medical and Pathological sections. The discussion was led by Dr. G. A. Heron, of London, who said that he was responsible for more than 2,000 injections of it. He held strongly to the opinion that it had great value both from the diagnostic as well as therapeutic standpoint, and as to the possibility of harm, he said "I am strongly of the opinion that it is at least as safe to the patient as is any other very potent drug." Prof. Koch followed, and said that from a study of over 3,000 cases he was convinced that as a diagnostic test, tuberculin was almost absolute. In early and uncomplicated cases of tuberculosis it was of great value therapeutically, and complete cure often followed its use. To obtain its full value the temperature of the patient should be normal before making the injections. The value of tuberculin for diagnosis was upheld by Dr. Osler, of Baltimore, but he regarded its therapeutic power as limited. Prof. McCall Anderson, of Glasgow, regarded it as invaluable for diagnosis, and of great benefit in cases of external tuberculosis. The chief opponent to the use of tuberculin was Dr. Theodore Williams, of the Brompton Hospital, who after repeated trials had abandoned it entirely. He held that even in early cases of phthisis it caused destruction of long tissue, and even if a temporary arrest of the disease followed, cure was not certain.

While there was no vote taken as to the sense of the meeting, it is my impression that the weight of opinion was that tuberculin had much value for diagnostic purposes, and that it produced no bad effects.

Prof. Robert Koch was the chief speaker at the second general meeting, held at St. James' Hall on Tuesday afternoon, July 23. The views announced were so contrary to the former teachings of Prof. Koch, and to the opinions generally held, that his address caused much excitement, as well as consternation. It is given in full below:

THE COMBATING OF TUBERCULOSIS IN THE LIGHT OF THE EXPERIENCE THAT HAS BEEN GAINED IN THE SUCCESSFUL COMBATING OF OTHER INFECTIOUS DISEASES.

"The task with which this Congress will have to busy itself is one of the most difficult; but it is also one in which labor is most sure of its reward.

I need not point again to the innumerable victims that tuberculosis annually claims in all countries, nor to the boundless misery it brings on the families it attacks. You all know that there is no disease which inflicts such deep wounds on mankind as this. All the greater, however, would be the general joy and satisfaction if the efforts that are being made to rid mankind of this enemy, which consumes its inmost marrow, were crowned with success.

There are many, indeed, who doubt the possibility of successfully combating this disease, which has existed for thousands of years, and has spread all over the world. This is by no means my opinion. This is a conflict into which we may enter with a surely founded prospect of success, and I will tell you the reasons on which I base this conviction.

Only a few decades ago the real nature of tuberculosis was unknown to us; it was regarded as a consequence, as the expression, so to speak, of social misery, and, as this supposed cause could not be got rid of by simple means, people relied on the probable gradual improvement of social conditions, and did nothing. All this is altered now. We know that social misery does indeed go far to foster tuberculosis, but the real cause of the disease is a parasite—that is, a visible and palpable enemy, which we can pursue and annihilate, just as we can pursue and annihilate other parasitic enemies of mankind.

Strictly speaking, the fact that tuberculosis is a preventable disease ought to have become clear as soon as the tubercle-bacillus was discovered, and the properties of this parasite and the manner of its transmission became known. I may add that I, for my part, was aware of the full significance of this discovery from the first, and so will everybody have been who had convinced himself of the causal relation between tuberculosis and the tubercle-bacillus. But the strength of a small number of medical men was inadequate to the conflict with a disease so deeply rooted in our habits and customs. Such a conflict the co-operation of many, if possible of all, medical

men, shoulder to shoulder with the State and the whole population; but now the moment when such co-operation is possible seems to have come. I suppose there is hardly any medical man now who denies the parasitic nature of tuberculosis, and among the non-medical public too the knowledge of the nature of the disease has been widely propagated.

Another favorable circumstance is that success has recently been achieved in the combating of several parasitic diseases, and that we have learned from these examples how the conflict with pestilences is to be carried on.

The most important lesson we have learned from the said experience is that it is a great blunder to treat pestilences uniformly. This was done in former times; no matter whether the pestilence in question was cholera, plague, or leprosy; isolation, quarantine, useless disinfection were always resorted to. But now we know that every disease must be treated according to its own special individuality, and that the measures to be taken against it must be most accurately adapted to its special nature, to its etiology. We are entitled to hope for success in combating tuberculosis only if we keep this lesson constantly in view. As so extremely much depends just on this point, I shall take the liberty to illustrate it by several examples. The pestilence which is at this moment in the foreground of interest, the bubonic plague, may be instructive to us in several respects.

People used to act upon the conviction that a plague patient was in the highest degree a centre of infection, and that the disease was transmitted only by plague patients and their belongings. Even the most recent international agreements are based on this conviction. Although, as compared with formerly, we now have the great advantage that we can, with the aid of the microscope and of experiments on animals, recognize every case of plague with absolute certainty, and although the prescribed inspection of ships, quarantine, the isolation of patients, the disinfection of infected dwellings and ships, are carried out with the utmost care, the plague has, nevertheless, been transmitted everywhere and has, in not a few places, assumed grave dimensions. Why this has happened we know very well, owing to the experience quite recently gained as to the manner in which the plague is transmitted. It has been discovered that only those plague patients that suffer from plague-pneumonia—a condition which is fortunately infrequent—are centres of infection, and that the real transmitters of the plague are the rats. There is no longer any doubt that, in by far the majority of the cases in which the plague has been transmitted by ocean traffic, the transmission took place by means of plague among the ship rats. It has also been

found that, wherever the rats were intentionally or unintentionally exterminated, the plague rapidly disappeared; whereas at other places, where too little attention had been paid to the rat plague, the pestilence continued. This connection between the human plague and the rat plague was totally unknown before, so that no blame attaches to those who devised the measures now in force against the plague if the said measures have proved unavailing. It is high time, however, that this enlarged knowledge of the etiology of the plague be utilized in international as well as in other traffic. As the human plague is so dependent on the rat plague, it is intelligible that protective inoculation and the application of antitoxic serum have so little effect. A certain number of human beings may have been saved from the disease by that, but the general spread of the pestilence has not been hindered in the least.

With cholera the case is essentially different; it may, under certain circumstances, be transmitted directly from human beings to other human beings, but its main and most dangerous propagator is water, and therefore, in the combating of cholera, water is the first thing to be considered. In Germany, where this principle has been acted on, we have succeeded for four years in regularly exterminating the pestilence (which was introduced again and again from the infected neighboring countries) without obstruction of traffic.

Hydrophobia too is not void of instruction for us. Against this disease the so-called protective inoculation has proved eminently effective as a means of preventing the outbreak of the disease in persons already infected, but, of course, such a measure can do nothing to prevent infection itself. The only real way of combating this pestilence is by compulsory muzzling. In this matter also we have had the most satisfactory experience in Germany, but have at the same time seen that the total extermination of the pestilence can be achieved only by international measures, because hydrophobia, which can be very easily and rapidly suppressed, is always introduced again year after year from the neighboring countries.

Permit me to mention only one other disease, because it is etiologically very closely akin to tuberculosis, and we can learn not a little for the furtherance of our aims from its successful combating. I mean leprosy. It is caused by a parasite which greatly resembles the tubercle-bacillus. Just like tuberculosis, it does not break out till long after infection, and its course is almost slower. It is transmitted only from person to person, but only when they come into close contact, as in small dwellings and bedrooms. In this disease, accordingly, immediate transmission plays the main part; transmission by animals, water, or the like is out of the question. The combative measures, accordingly, must be directed against this close intercourse between the sick and the healthy. The only way to pre-

vent this intercourse is to isolate the patients. This was most rigorously done in the Middle Ages by means of numerous leper-houses, and the consequence was that leprosy, which had spread to an alarming extent, was completely stamped out in Central Europe. The same method has been adopted quite recently in Norway, where the segregation of lepers has been ordered by a special law. But it is extremely interesting to see how this law is carried out. It has been found that it is not at all necessary to execute it strictly, for the segregation of only the worst cases, and even of only a part of these, sufficed to produce a diminution of leprosy. Only so many infectious cases had to be sent to the leper-houses that the number of fresh cases kept regularly diminishing from year to year. Consequently the stamping-out of the disease has lasted much longer than it would have lasted if every leper had been inexorably consigned to a leper-house, as in the Middle Ages; but in this way too the same purpose is gained, slowly indeed, but without any harshness.

These examples may suffice to show what I am driving at, which is to point out that, in combating pestilences, we must strike at the root of the evil, and must not squander force in subordinate ineffective measures. Now the question is whether what has hitherto been done, and what is about to be done against tuberculosis really strikes at the root of tuberculosis, so that it must sooner or later die.

In order to answer this question it is necessary first and foremost to inquire how infection takes place in tuberculosis. Of course, I presuppose that we understand by tuberculosis only those morbid conditions which are caused by the tubercle-bacillus.

In by far the majority of cases of tuberculosis the disease has its seat in the lungs, and has also begun there. From this fact it is justly concluded that the germs of the disease, *i.e.*, the tubercle-bacilli, must have got into the lungs by inhalation. As to the question where the inhaled tubercle-bacilli have come from, there is also no doubt. On the contrary, we know with certainty that they get into the air with the sputum of consumptive patients. This sputum, especially in advanced stages of the disease, almost always contains tubercle-bacilli, sometimes in incredible quantities. By coughing, and even speaking, it is flung into the air in little drops, *i.e.*, in a moist condition, and can at once infect persons who happen to be near the coughers. But then it may also be pulverized when dried, in the linen or on the floor for instance, and get into the air in the form of dust.

In this manner a complete circle, a so-called *circulus vitiosus*, has been formed for the process of infection, from the diseased lung, which produces phlegm and pus containing tubercle-bacilli, to the formation of moist and dry particles (which, in virtue of their smallness, can keep floating a good while in the air), and finally to new

infection, if particles penetrate with the air into a healthy lung and originate the disease anew. But the tubercle-bacilli may get to other organs of the body in the same way, and thus originate other forms of tuberculosis. This, however, is a considerably rarer case. The sputum of consumptive people, then, is to be regarded as the main source of the infection of tuberculosis. On this point, I suppose, all are agreed. The question now arises whether there are not other sources too, copious enough to demand consideration in the combating of tuberculosis.

Great importance used to be attached to the hereditary transmission of tuberculosis. Now, however, it has been demonstrated by thorough investigation that, though hereditary tuberculosis is not absolutely non-existent, it is nevertheless extremely rare, and we are at liberty, in considering our practical measures, to leave this form of origination entirely out of account.

But another possibility of tubercular infection exists, as is generally assumed, in the transmission of the germs of the disease from tubercular animals to man. This manner of infection is generally regarded nowadays as proved, and as so frequent that it is even looked upon by not a few as the most important, and the most rigorous measures are demanded against it. In this Congress also the discussion of the danger with which the tuberculosis of animals threatens man will play an important part. Now, as my investigations have led me to form an opinion deviating from that which is generally accepted, I beg your permission, in consideration of the great importance of this question, to discuss it a little more thoroughly.

Genuine tuberculosis has hitherto been observed in almost all domestic animals, and most frequently in poultry and cattle. The tuberculosis of poultry, however, differs so much from human tuberculosis that we may leave it out of account as a possible source of infection for man. So, strictly speaking, the only kind of animal tuberculosis remaining to be considered is the tuberculosis of cattle, which, if really transferable to man, would indeed have frequent opportunities of infecting human beings through the drinking of the milk and the eating of the flesh of diseased animals.

Even in my first circumstantial publication on the etiology of tuberculosis I expressed myself regarding the identiy of human tuberculosis and bovine tuberculosis with reserve. Proved facts which would have enabled me sharply to distinguish these two forms of the disease were not then at my disposal, but sure proofs of their absolute identity were equally undiscoverable, and I therefore had to leave this question undecided. In order to decide it, I have repeatedly resumed the investigations relating to it, but so long as I

experimented on small animals, such as rabbits and guinea-pigs, I failed to arrive at any satisfactory results, though indications which rendered the difference of the two forms of tuberculosis probable were not wanting. Not till the complaisance of the Minister of Agiculture enabled me to experiment on cattle, the only animals really suitable for these investigations, did I arrive at absolutely conclusive results. Of the experiments which I have carried out during the last two years along with Professor Shüetz, of the Veterinary College in Berlin, I will tell you briefly some of the most important.

A number of young cattle which had stood the tuberculin test, and might therefore be regarded as free from tuberculosis, were infected in various ways with pure cultures of tubercle-bacilli taken from cases of human tuberculosis; some of them got the tubercular sputum of consumptive patients direct. In some cases the tubercle-bacilli or the sputum were injected under the skin, in others into the peritoneal cavity, in others into the jugular vein. Six animals were fed with tubercular sputum almost daily for seven or eight months; four repeatedly inhaled great quantities of bacilli, which were distributed in water, and scattered with it in the form of spray. None of these cattle (there were nineteen of them) showed any symptoms of disease, and they gained considerably in weight. From six to eight months after the beginning of the experiments they were killed. In their internal organs not a trace of tuberculosis was found. Only at the places where the injections had been made small suppurative foci had formed, in which few tubercle-bacilli could be found. This is exactly what one finds when one injects dead tubercle-bacilli under the skin of animals liable to contagion. So the animals we experimented on were affected by the living bacilli of human tuberculosis exactly as they would have been by dead ones; they were absolutely insusceptible to them.

The result was utterly different, however, when the same experiment was made on cattle free from tuberculosis with tubercle-bacilli that came from the lungs of an animal suffering from bovine tuberculosis. After an incubation-period of about a week the severest tubercular disorders of the internal organs broke out in all the infected animals. It was all one whether the infecting matter had been injected only under the skin or into the peritoneal cavity or the vascular system. High fever set in, and the animals became weak and lean; some of them died after a month and a half to two months, others were killed in a miserably sick condition after three months. After death, extensive tubercular infiltrations were found at the place where the injections had been made, and in the neighboring lymphatic glands, and also far advanced alterations of the internal organs, especially the lungs and the spleen. In the cases in which the injection had been made into the peritoneal cavity the tubercular

growths which are so characteristic of bovine tuberculosis were found on the omentum and peritoneum. In short, the cattle proved just as susceptible to infection by the bacillus of bovine tuberculosis as they had proved insusceptible to infection by the bacillus of human tuberculosis. I wish only to add that preparations of the organs of the cattle which were artificially infected with bovine tuberculosis in these experiments are exhibited in the Museum of Pathology and Bacteriology.

An almost equally striking distinction between human and bovine tuberculosis was brought to light by a feeding experiment with swine. Six young swine were fed daily for three months with the tubercular sputum of consumptive patients. Six other swine received bacilli of bovine tuberculosis with their food daily for the same period. The animals that were fed with sputum remained healthy and grew lustily, whereas those that were fed with the bacilli of bovine tuberculosis soon became sickly, were stunted in their growth, and half of them died. After three months and a half the surviving swine were all killed and examined. Among the animals that had been fed with sputum not a trace of tuberculosis was found, except here and there little nodules in the lymphatic glands of the neck, and in one case a few grey nodules in the lungs. The animals, on the other hand, which had eaten bacilli of bovine tuberculosis had, without exception (just as in the cattle experiment), severe tubercular diseases, especially tubercular infiltration of the greatly enlarged lymphatic glands of the neck and of the mesenteric glands, and also extensive tuberculosis of the lungs and the spleen.

The difference between human and bovine tuberculosis appeared not less strikingly in a similar experiment with asses, sheep and goats, into whose vascular systems the two kinds of tubercle-bacilli were injected.

Our experiments, I must add, are not the only ones that have led to this result. If one studies the older literature of the subject, and collates the reports of the numerous experiments that were made in former times by Chauveau, Günther, Harms, Bollinger, and others, who fed calves, swine and goats with tubercular material, one finds that the animals that were fed with the milk and pieces of the lungs of tubercular cattle always fell ill of tuberculosis, whereas those that received human material with their food did not. Comparative investigations regarding human and bovine tuberculosis have been made very recently in North America by Smith, Dinwiddie and Frothingham, and their result agreed with that of ours. The unambiguous and absolutely conclusive result of our experiments is due to the fact that we chose methods of infection which exclude all sources of error, and carefully avoided everything connected with the stalling, feeding, and tending of the animals that might have a disturbing effect on the experiments.

Considering all these facts, I feel justified in maintaining that human tuberculosis differs from bovine, and cannot be transmitted to cattle. It seems to me very desirable, however, that these experiments should be repeated elsewhere, in order that all doubt as to the correctness of my assertion may be removed.

I wish only to add that, owing to the great importance of this matter, the German Government has appointed a commission to make further inquiries on the subject.

But, now, how is it with the susceptibility of man to bovine tuberculosis? This question is far more important to us than that of the susceptibility of cattle to a human tuberculosis, highly important as that is too. It is impossible to give this question a direct answer, because, of course, the experimental investigation of it with human beings is out of the question. Indirectly, however, we can try to approach it. It is well known that the milk and butter consumed in great cities very often contain large quantities of the bacilli of bovine tuberculosis in a living condition, as the numerous infection-experiments with such dairy products on animals have proved. Most of the inhabitants of such cities daily consume such living and perfectly virulent bacilli of bovine tuberculosis, and unintentionally carry out the experiment which we are not at liberty to make. If the bacilli of bovine tuberculosis were able to infect human beings, many cases of tuberculosis caused by the consumption of alimenta containing tubercle-bacilli could not but occur among the inhabitants of great cities, especially the children. And most medical men believe that this is actually the case.

In reality, however, it is not so. That a case of tuberculosis has been caused by alimenta can be assumed with certainty only when the intestine suffers first—*i.e.*, when a so-called primary tuberculosis of the intestine is found. But such cases are extremely rare. Among many cases of tuberculosis examined after death, I myself remember having seen primary tuberculosis of the intestine only twice. Among the great *post-mortem* material of the Charité Hospital in Berlin ten cases of primary tuberculosis of the intestine occurred in five years. Among 933 cases of tuberculosis in children at the Emperor and Empress Frederick's Hospital for Children, Baginsky never found tuberculosis of the intestine without simultaneous disease of the lungs and the bronchial glands. Among 3,104 *post-mortems* of tubercular children, Biedert observed only sixteen cases of primary tuberculosis of the intestine. I could cite from the literature of the subject many more statistics of the same kind, all indubitably showing that primary tuberculosis of the intestine, especially among children, is a comparatively rare disease, and of these few cases that have been enumerated, it is by no means certain that they were due to infection by bovine tuberculosis. It is just as

likely that they were caused by the widely propagated bacilli of human tuberculosis, which may have got into the digestive canal in some way or other—for instance, by swallowing saliva of the mouth. Hitherto nobody could decide with certainty in such a case whether the tuberculosis of the intestine was of human or of animal origin. Now we can diagnose them. All that is necessary is to cultivate in pure culture the tubercle-bacilli found in the tubercular material, and to ascertain whether they belong to bovine tuberculosis by inoculating cattle with them. For this purpose I recommend subcutaneous injection, which yields quite specially characteristic and convincing results. For half a year past I have occupied myself with such investigations, but, owing to the rareness of the disease in question, the number of the cases I have been able to investigate is but small. What has hitherto resulted from this investigation does not speak for the assumption that bovine tuberculosis occurs in man.

Though the important question whether man is susceptible to bovine tuberculosis at all is not yet absolutely decided, and will not admit of absolute decision to-day or to-morrow, one is nevertheless already at liberty to say that, if such a susceptibility really exists, the infection of human beings is but a very rare occurrence. I should estimate the extent of infection by the milk and flesh of tubercular cattle, and the butter made of their milk, as hardly greater than that of hereditary transmission, and I therefore do not deem it advisable to take any measures against it.

So the only main source of the infection of tuberculosis is the sputum of consumptive patients, and the measures for the combating of tuberculosis must aim at the prevention of the dangers arising from its diffusion. Well, what is to done in this direction? Several ways are open. One's first thought might be to consign all persons suffering from tuberculosis of the lungs, whose sputum contains tubercle-bacilli to suitable establishments. This, however, is not only absolutely impracticable, but also unnecessary. For a consumptive who coughs out tubercle-bacilli is not necessarily a source of infection on that account, so long as he takes care that his sputum is properly removed and rendered inocuous. This is certainly true of very many patients, especially in the first stages, and also of those who belong to the well-to-do classes, and are able to procure necessary nursing. But how is it with people of very small means? Every medical man who has often entered the dwellings of the poor, and I can speak on this point from my own experience, knows how sad is the lot of consumptives and their families there. The whole family have to live in one or two small, ill-ventilated rooms. The patient is left without the nursing he needs, because the able-bodied members of the family must go to their

work. How can the necessary cleanliness be secured under such circumstances? How is such a helpless patient to remove his sputum, so that it may do no harm? But let us go a step further and picture the condition of a poor consumptive patient's dwelling at night. The whole family sleep crowded together in one small room. However cautious he may be, the sufferer scatters the morbid matter secreted by his diseased lungs every time he coughs, and his relatives close beside him must inhale this poison. Thus whole families are infected. They die out, and awaken in the minds of those who do not know the infectiousness of tuberculosis the opinion that it is hereditary, whereas its transmission in the cases in question was due solely to the simplest processes of infection, which do not strike people so much, because the consequences do not appear at once, but generally only after the lapse of years.

Often, under such circumstances, the infection is not restricted to a single family, but spreads in densely inhabited tenement-houses to the neighbours, and then, as the admirable investigations of Biggs have shown in the case of the densely peopled parts of New York, regular nests or foci of disease are formed. But, if one investigates these matters more thoroughly, one finds that it is not poverty *per se* that favors tuberculosis, but the bad domestic conditions under which the poor everywhere, but especially in great cities, have to live. For, as the German statistics show, tuberculosis is less frequent, even among the poor, when the population is not densely packed together, and may attain very great dimensions among a well-to-do population when the domestic conditions, especially as regards the bedrooms, are bad, as is the case, for instance, among the inhabitants of the North Sea coast. So it is the overcrowded dwellings of the poor that we have to regard as the real breeding-places of tuberculosis; it is out of them that the disease always crops up anew, and it is to the abolition of these conditions that we must first and foremost direct our attention if we wish to attack the evil at its root, and to wage war against it with effective weapons.

This being so, it is very gratifying to see how efforts are being made in almost all countries to improve the domestic conditions of the poor. I am also convinced that these efforts, which must be promoted in every way, will lead to a considerable diminution of tuberculosis. But a long time must elapse ere essential changes can be effected in this direction, and much may be done meanwhile in order to reach the goal much more rapidly.

If we are not able at present to get rid of the danger which small and overcrowded dwellings involve, all we can do is to remove the patients from them, and, in their own interests and that of the peo-

ple about them, to lodge them better; and this can be done only in suitable hospitals. But the thought of attaining this end by compulsion of any kind is very far from me; what I want is that the consumptives may be enabled to obtain the nursing they need better than they can obtain it now. At present a consumptive in an advanced stage of the disease is regarded as incurable and as an unsuitable inmate for a hospital. The consequence is that he is reluctantly admitted and dismissed as soon as possible. The patient too, when the treatment seems to him to produce no improvement, and the expenses, owing to the long duration of his illness, weigh heavily upon him, is himself animated by the wish to leave the hospital soon. That would be altogether altered if we had special hospitals for consumptives, and if the patients were taken care of there for nothing, or at least at a very moderate rate. To such hospitals they would willingly go; they could be better treated and cared for there than is now the case. I know very well that the execution of the project will have great difficulties to contend with, owing to the considerable outlay it entails. But very much would be gained if, at least in the existing hospitals, which have to admit a great number of consumptives at any rate, special wards were established for them, in which pecuniary facilities would be offered them. If only a considerable fraction of the whole number of consumptives were suitably lodged in this way, a diminution of infection and consequently of the sum-total of tuberculosis could not fail to be the result.

Permit me to remind you in this connection of what I said about leprosy. In the combating of that disease also great progress has already been made by lodging only a fair number of the patients in hospitals. The only country that possesses a considerable number of special hospitals for tubercular patients is England, and there can be no doubt that the diminution of tuberculosis in England, which is much greater than in any country, is greatly due to this circumstance. I should point to the founding of special hospitals for consumptives and the better utilization of the already existing hospitals for the lodging of consumptives as the most important measure in the combating of tuberculosis, and its execution opens a wild field of activity to the state, to municipalities, and to private benevolence. There are many people who possess great wealth, and would willingly give of their superfluity for the benefit of their poor and heavily afflicted fellow-creatures, but do not know how to do this in a judicious manner. Here is an opportunity for them to render a real and lasting service by founding Consumption Hospitals or purchasing the right to have a certain number of consumptive patients maintained in special wards of other hospitals free of expense.

As, however, unfortunately, the aid of the state, the municipalities, and rich benefactors will probably not be forthcoming for a long time yet, we must for the present resort to other measures that may pave the way for the main measure just referred to, and serve as a supplement and temporary substitute for it.

Among such measures I regard obligatory notification as specially valuable. In the combating of all infectious diseases it has proved indispensable as a means of obtaining certain knowledge as to their state, especially their dissemination, their increase and decrease. In the conflict with tuberculosis also we cannot dispense with obligatory notification; we need it not only in order to inform ourselves as to the dissemination of this disease, but mainly in order to learn where help and instruction can be given, and especially where the disinfection which is so urgently necessary when consumptives die or change their residence has to be effected. Fortunately it is not at all necessary to notify all cases of tuberculosis, nor even all cases of consumption, but only those that, owing to the domestic conditions, are sources of danger to the people about them. Such limited notification has already been introduced in various places, in Norway, for instance, by a special law, in Saxony by a ministerial decree, in New York and in several American towns, which have followed its example. In New York, where notification was optional at first and was afterwards made obligatory, it has proved eminently useful. It has thus been proved that the evils which it used to be feared the introduction of notification for tuberculosis would bring about need not occur, and it is devoutly to be wished that the examples I have named may very soon excite emulation everywhere.

There is another measure, closely connected with notification, viz., disinfection, which, as already mentioned, must be effected when consumptives die or change their residence, in order that those who next occupy the infected dwelling may be protected against infection. Moreover, not only the dwellings but also the infected beds and clothes of consumptives ought to be disinfected.

A further measure, already recognized on all hands as effective, is the instructing of all classes of the people as to the infectiousness of tuberculosis, and as to the best way of protecting oneself. The fact that tuberculosis has considerably diminished in almost all civilized states of late is attributed solely to the circumstance that knowledge of the contagious character of tuberculosis has been more and more widely disseminated, and that caution in intercourse with consumptives has increased more and more in consequence. If better knowledge of the nature of tuberculosis has alone sufficed to prevent a large number of cases, this must serve us as a significant admonition to make the greatest possible use of this means, and to do more and more to bring it about that everybody know the dangers

that threaten him in intercourse with consumptives. It is only to be desired that the instructions may be made shorter and more precise than they generally are, and that special emphasis be laid on the avoidance of the worst danger of infection, which is the use of bedrooms and small ill-ventilated workrooms simultaneously with consumptives. Of course the instructions must include directions as to what consumptives have to do when they cough and how they are to treat their sputum.

Another measure, which has come into the foreground of late, and which at this moment plays to a certain extent a paramount part in all efforts for the combating of tuberculosis, works in quite another direction. I mean the founding of sanatoria for consumptives.

That tuberculosis is curable in its early stages must be regarded as an undisputed fact. The idea of curing as many tubercular patients as possible in order to reduce the number of those that reach the infectious stage of consumption, and thus to reduce the number of fresh cases, was therefore a very natural one. The only question is whether the number of persons cured in this way will be great enough to exercise an appreciable influence on the retrogression of tuberculosis. I will try to answer this question in the light of the figures at my disposal.

According to the business report of the German Central Committee for the Establishment of Sanatoria for the Cure of Consumptives, about 5,500 beds will be at the disposal of these institutions by the end of 1901, and then, if we assume that the average stay of each patient will be three months, it will be possible to treat at least 20,000 patients every year. From the reports hitherto issued as to the results that have been achieved in the establishments, we learn further that about 20 per cent. of the patients that have tubercle-bacilli in their sputum lose them by the treatment there. This is the only sure test of success, especially as regards prophylaxis. If we make this the basis of our estimates, we find that 4,000 consumptives will leave these establishments annually as cured. But, according to the statistics ascertained by the German Imperial Office of Health, there are 226,000 persons in Germany over fifteen years of age who are so far gone in consumption that hospital-treatment is necessary for them. Compared with this great number of consumptives the success of the establishments in question seems so small that a material influence on the retrogression of tuberculosis in general is not yet to be expected of them. But pray do not imagine that I wish, by this calculation of mine, to oppose the movement for the establishment of such sanatoria in any way. I only wish to warn against the over-estimating of their importance which has recently been observable in various quarters, based apparently on the opinion that the war against tuberculosis can be waged by means of

sanatoria alone, and that other measures are of subordinate value. In reality the contrary is the case. What is to be achieved by the general prophylaxis resulting from recognition of the danger of infection and the consequent greater caution in intercourse with consumptives is shown by a calculation of Cornet's regarding the decrease of mortality from tuberculosis in Prussia in the years 1889 to 1897. Before 1889 the average was 31.4 per 10,000, whereas in the period named it sank to 21.8, which means that, in that short space of time, the number of deaths from tuberculosis was 184,000 less than was to be expected from the average of the preceding years. In New York, under the influence of the general sanitary measures directed in a simply exemplary manner by Biggs, the mortality from tuberculosis has diminished by more than 35 per cent. since 1886. And it must be remembered that both in Prussia and New York the progress indicated by these figures is due to the first beginnings of these measures. Considerably greater success is to be expected of their further development. Biggs hopes to have got so far in five years that in the city of New York alone the annual number of deaths from tuberculosis will be 3,000 less than formerly. I take this opportunity of most urgently recommending Dr. Biggs' organization to the study and imitation of all municipal sanitary authorities.

Now, I do indeed believe that it will be possible to render the sanatoria considerably more efficient. If strict care be taken that only patients be admitted for whom the treatment of those establishments is well adapted, and if the duration of the treatment be prolonged, it will certainly be possible to cure fifty per cent., and perhaps still more. But even then, and even if the number of the sanatoria be greatly increased, the total effect will always remain but moderate. The sanatoria will never render the other measures I have mentioned superfluous. If their number become great, however, and if they perform their functions properly, they may materially aid the strictly sanitary measures in the conflict with tuberculosis.

If now, in conclusion, we glance back once more to what has been done hitherto for the combating of tuberculosis, and forward to what has still to be done, we are at liberty to declare with a certain satisfaction that very promising beginnings have already been made. Among these I reckon the consumption hospitals of England, the legal regulations regarding notification in Norway and Saxony, the organization created by Biggs in New York, the sanatoria, and the instruction of the people. All that is necessary is to go on developing these beginnings, to test, and if possible to increase their influence on the diminution of tuberculosis, and wherever nothing has yet been done, to do likewise.

If we are continually guided in this enterprise by the spirit of genuine preventive medical science, if we utilize the experience

gained in conflict with other pestilences, and aim, with clear recognition of the purpose and resolute avoidance of wrong roads, at striking the evil at its root, then the battle against tuberculosis, which has been so energetically begun, cannot fail to have a victorious issue."

REPLY OF LORD LISTER TO PROF. KOCH.

He said that the discourse they had listened to was full of profound interest from the beginning to the end. But what had chiefly riveted their attention had been the startling thesis that bovine tubercle could not develop in the human body. This was a matter of enormous practical importance because if this conclusion were sound it would greatly simplify their preventive measures, but it would be a very serious and grievous thing if the rules now in force for securing purity of milk supply should be relaxed and it should turn out after all that the conclusion was erroneous. For his own part he thought the evidence adduced by Dr. Koch to show that human tubercle could not be communicated to bovine animals very inconclusive. At the same time he agreed with him that in a matter of such great importance further inquiry was desirable. But even if that were established it would by no means necessarily follow that bovine tubercle could not be communicated to man. He took in illustration the case of variola. Attempts to inoculate human small-pox into the calf had been so very rarely successful that eminent pathologists had concluded that small-pox and cow-pox were two entirely different diseases. We now know that this was an entire mistake; that cow-pox was small-pox modified by passing through the cow. He referred to some very instructive experiments by Dr. Monckton Copeman, who entirely failed to inoculate human small-pox into the calf but invariably succeeded in inoculating it into the monkey, and was as invariably successful when he introduced matter from the pustules in the monkey into the calf, the result being ordinary cow-pox which could be used for vaccinating children. It might be that some species of animals might serve as an intermediary host for tubercle between man and the bovine species. Or it might turn out that, if a sufficient number of experiments were made, human tubercle might prove occasionally transmissible to the bovine animal, as small-pox was in rare instances to the calf, and that the bovine tubercle so produced might be transmissible to man, as was the virus of vaccine. The evidence, necessarily indirect, on which Koch relied as showing that bovine tubercle could not be transmitted to man, did not seem at all conclusive. It consisted mainly in the alleged rarity of primary tuberculous intestinal lesions in children in spite of the multitudes of tubercle bacilli swallowed by them in milk. Even if it were admitted that primary

tuberculous intestinal lesions were as rare in children as Koch's statistics indicated, it was certainly true that *tabes mesenterica* existed in a considerable percentage of children who died from tuberculous disease without tubercle being found in any other part of the body.

When the mesenteric glands were thus affected without any discoverable intestinal lesion, the natural, and indeed, inevitable, interpretation seemed to him to be that the tubercle bacilli had passed through the intestinal mucous membrane without causing obvious lesion in it, and had been arrested in the glands of the mesentery. It was known that even typhoid bacilli, the essential place of development of which was the intestinal mucous membrane, occasionally passed through without producing the characteristic lesion. And if this might occur with the typhoid bacilli, how much more likely was such an occurence with tubercle bacilli? If this were so, Koch's main argument fell to the ground. As regarded the experiments which Koch had referred to of inoculating bovine animals with material from the glands of children affected with *tabes mesenterica*, the result being negative, these experiments had been but few; and even were they more numerous, they would not, to his mind, be quite conclusive. It might be that tubercle from milk in the intestines might be so modified by passing through the human subject that the bacilli in the mesenteric glands, though derived from a bovine animal, might be no longer those of true bovine tubercle but bacilli having the characters of human tubercle little disposed to develop in cattle. The Congress would probably require a more searching inquiry into the subject before accepting this doctrine of the immunity of man to bovine tubercle.

REPLY OF PROF. E. NOCARD TO PROF. KOCH.

"I consider it a great honor to salute, in the name of French bacteriologists, the greatest bacteriologist of the whole world. To this tribute of admiration and respect, I ask of this illustrious savant permission to make public acknowledgement of the gratitude which I expressed to him nearly ten years ago on an occasion never to be forgotten, when I was able to judge of the elevation of his mind, the nobility of his character, and the rare goodness of his heart.*

A communication from Koch is always an event; that of to-day will be heard far and wide. Parts of it charm me and fill me with content; other parts trouble me, they appear to me full of danger.

* Allusion is here made to the sympathetic devotion shown by Prof. Koch to the French Commission, composed of Messrs. Roux, Strauss, Nocard and Thuillier, sent to Egypt in 1893 to study the epidemic of cholera. It will be remembered that in 48 hours Thuillier was carried off by the disease.

I may be thought audacious to discuss the work of a master who is authority in all matters which concern bacteriology, and above all in regard to tuberculosis. I know that my intervention is somewhat dangerous; however, the interests at stake are so important and the conclusions from Koch's work so fraught with grave consequences, that I cannot hesitate to respond to the invitation of our illustrious president, Lord Lister, to speak my sentiments on the subject.

That which pleases me in the communication of Koch is that he justifies in a clear manner the efforts of those who protest against extreme methods in the prophylactic measures designed to protect the human race against the dangers of bovine tuberculosis. For some years a salutary reaction has taken place against the extreme measures at first adopted. The communication of Koch will accomplish this end; perhaps it goes to extremes in the inverse sense, and I fear greatly that after having advised excessive and absurd measures against imaginary dangers, people may now neglect to take precautions against the real dangers which exist for the public health in bovine tuberculosis.

I have always held, and recently again at the Berlin Congress on Tuberculosis, that bovine tuberculosis plays but a small part in the spread of human tuberculosis; but no matter how small this part may be, it is undeniable, and it would be a great mistake to leave it out of consideration.

Koch has not succeeded in producing tuberculosis in cattle inoculated by various methods with cultures or material from human source. He concludes from this that cattle are refractory to human tuberculosis; that man has nothing to fear from tuberculosis of cattle, and that it is useless to take precautions against it.

With all the respect due to the illustrious savant, but with all the strength of profound conviction, I wish to say that his experiments do not justify such conclusions.

It is a principle of the experimental method that negative results, however great their number, cannot outweigh positive facts. There exist positive facts proving that it is possible to infect cattle with tuberculous matter from man. The first of these are the experiments of my eminent master, Professor Chauveau. I regret extremely that his duties prevented him from taking part in this Congress; he could have presented them with the authority which belongs to a master of experimental medicine. I will endeavor to take his place, and to show the value of these facts from the point of view which now engages us.

Among his numerous experiments on this subject there are four which are particularly strong, in which calves aged from five to ten months were infected by the digestive tract, or by intravenous in-

jection, tuberculous material from man. (Acute phthisis or caseous pneumonia). These four animals were killed at different times up to fifty-nine days, and at the autopsy showed very important lesions, manifestly the result of the experimental infection.

In two of the three calves infected by ingestion the lesions were confluent in the intestine, the mesenteric glands, and on the peritoneum. In the third calf, on the contrary, while there were slight lesions of the abdominal organs, there existed very important ones in the glands related to the first part of the digestive tract, namely, the retro-pharyngeal and oesophageal glands.

Some will, no doubt, raise the objection to these experiments, that dating back to a period so far in the past, when tuberculin was not known, it was impossible to be sure that the calves used in the experiment were free from tuberculosis. Chauveau had foreseen this objection. He had chosen young calves for his experiments because tuberculosis in calves is extremely rare. He procured these calves in a district where tuberculosis of cows was unknown; and finally, in each experiment he preserved as controls an equal number of calves of the same age and origin, which were killed at the same time as the others, and were found to be absolutely free from tuberculosis.

Old as they may be, these experiments of Chauveau have on that account none the less value as positive facts against which negative experiments cannot prevail, however numerous they may be. Furthermore, several members of this Congress are announced to communicate analogous facts with the proofs.

These facts prove that although it may be difficult to communicate human tuberculosis to cattle, it nevertheless succeeds at times. How can we explain these different results apparently contradictory? It is difficult to do this with certainty, for we cannot pretend that we are able to reproduce exactly in our experiments all the conditions of natural infection. It is, however, possible to give a plausible explanation. It is a well known general law that the gradual adaptation of any parasite to a medium, inert or living, in which it can succeed in developing, confers on it the aptitude to develop more easily in media like the first. This is true for the bacillus of tuberculosis as for all other microbes. We know how difficult it is to obtain the first growth of the bacillus of Koch even on the most favorable culture medium. The first culture is always thin and scanty, but when once accustomed to our culture medium, it grows afterwards quite quickly and abundantly. What is true of inert media is still more true, *a fortiori*, of living media. Every one knows that the bacillus of "rouget du porc" develops with difficulty at first in the organism of the rabbit. In order to kill one rabbit with certainty it is necessary to inoculate three of four animals, and death

only occurs after four or five days, sometimes longer; but by passing this microbe from rabbit to rabbit, it rapidly acquires such a degree of virulence that it kills rabbits in a few hours. But this bacillus, although become so virulent for rabbits, has lost all its virulence for swine, from which it comes originally; we can inoculate swine with large doses without killing them, and even without making them sick.

What I have said of the bacillus of "rouget du porc" applies also, and nearly as exactly, to the trypanosoma of dourine in the horse.

This parasite of a higher order is inoculable into dogs, the white mouse, and the white rat, among other animals. After some passages from mouse to mouse or from rat to rat, it acquires such a degree of virulence that the animals die in a few days showing an enormous number of trypanosomes in the blood. When, however, we inoculate the rat or mouse with this same trypanosoma after a certain number of passages through dogs, it no longer succeeds in killing them nor does it make them sick. The prolonged adaptation of the trypanosoma to the organism of the dog causes it to lose its power of developing in the organism of the white mouse or white rat; but a most curious thing, the trypanosoma of the dog remains always just as virulent for the horse.

Finally, I have shown that the tubercle bacillus from man or from cows cultivated in the peritoneal cavity of the chicken protected from phagocytic action, thanks to the protection of a collodion sac, acquires little by little the characters of the avian tubercle bacillus and becomes incapable of killing guinea-pigs, or kills them with lesions analogous to those of avian tuberculosis.

All these lead me to think that the results obtained by Prof. Koch proceed from causes of the same kind. Cattle rarely take tuberculosis from man, but when for some reason or other the resistance of the cells is modified, diminished or suppressed, the human bacillus can multiply and invade the organs of the subject in which the resistance has been overcome. After this, the bacillus adapted to its new surroundings is able to develop in other healthy cattle, which would show themselves refractory to the action of this same bacillus if it came directly from man. Let us admit for an instant that if cattle are really refractory to human tuberculosis, has one the right to conclude from this that the reverse is equally true? No, a hundred times no; this would be contrary to all the principles of the experimental method. It would be above all, contrary to facts. If experimental facts are lacking, and for cause, all clinical facts abound which prove the possibility of the transmissibility to man of tuberculosis of cattle. Many have seen veterinarians who have wounded themselves while making autopsies on tubercular cows. Some have gotten well, thanks to prompt and radical surgical intervention, such as our colleague Jensen, of the Veterinary School of

Copenhagen; others less fortunate, have succumbed to the progressive evolution of the infection, such as our brethren, Moses, of Weimar, and Thomas Walley, of the Royal Veterinary College of Edinburgh.

Furthermore, there exist numerous instances of infection by the use of milk coming from cows with tuberculous mammitis. The best known and most authoritative, concerns one of the daughters of Prof. Gosse, of Geneva. It has almost the value of an experiment.

Finally the work of the great English hygienist, Thorne-Thorne proves as well as evidence the reality and gravity of the danger. During fifty years the mortality from tuberculosis in England has diminished forty-five per cent.; during this same time, abdominal tuberculosis of infants has increased twenty-seven per cent. How can we explain these figures so different? It is only for the last fifty years that you have done much in this country towards the cleansing of the house, the work-shop, public places, lessening in this way the chances of infection by means of the respiratory tract, much the most common mode for adults; but you have done nothing against the dangers of infection by the digestive tract, which is the most frequent method for children artificially nourished.

Thorne-Thorne does not hesitate to attribute the increase of tuberculosis in young children to the absence of all regulations in regard to the dairy and of all measures prohibiting the use of milk coming from cows with tuberculosis of the udder. All those who study this question of milk agree with the opinion of Thorne-Thorne. It is for these reasons that I will continue to teach to-day as yesterday: 'Mothers of families; do not give milk to your babies unless the milk has been boiled.'"

Professor Bang, of Copenhagen, was then called upon by the chairman, and said that he thought Professor Koch had gone a little too far in saying that there was no necessity for taking measures against bovine tuberculosis. He had proved that there was very little danger in inoculating cattle from man, but the inoculation of man from cattle was a different matter, and they should be cautious in accepting his conclusions about it.

Professor Sims Woodhead (Cambridge), was also called upon. He said that Professor Koch's paper was a masterly exposition of his subject, but the very weight of his word going out to the world made it desirable that, if there was anything to be said on the other side, it should be known too. He was himself convinced that bovine tuberculosis did play some part in the extension of the disease and he adduced several reasons for his opinion. Among them he referred to an experiment of Professor Crookshank's, and said that one such positive result outweighed a large number of negative ones. Professor Koch had told them that a commission had

been appointed in Germany to make further investigations, and he suggested that the same should be done here, and that the Minister of Agriculture should be approached with that object in order that the question might be settled by actual experiment. But for the present he strongly urged that they should continue to take precautionary measures.

The paper of Prof. Koch contains two important statements which we may well examine into:

1. The claim that human tuberculosis differs from bovine, and cannot be transmitted to cattle.

2. That if man is really susceptible to bovine tuberculosis at all, the "infection of human beings is but a very rare occurrence. I should estimate the extent of infection by the milk and flesh of tubercular cattle, and the butter made of their milk, as hardly greater than of hereditary transmission, and I therefore do not deem it advisable to take any measures against it."

In regard to the first point we may admit that it is, in the main, true, though the statement of Prof. Koch goes too far. Indeed two of the authors quoted by him as having failed to induce tuberculosis in cattle by means of human products, Chauveau and Bollinger, should both be ranged on the opposite side. Chauveau was the first who ever experienced along these lines, and succeeded in infecting several animals of the bovine species with material from persons with tuberculosis. In the answer to Prof. Koch by Prof. Nocard just given above, these experiments are mentioned in some detail. They were given in full by Chauveau at the "Congress for the Study of Tuberculosis in Man and in Animals" held in Paris, France, on July 28, 1891, and may be found in the "Comptes Rendus et Memoires" of that Congress page 52. These experiments are so well known that Prof. Kcch's allusion is inexplicable.

Furthermore, Prof. Thomassen, of the Veterinary College, Utrecht, Holland, reported to the Congress the result of recent experiments by himself, in which he succeeded in producing an extensive general tuberculosis in one of four animals inoculated with human tubercle bacillus. The inoculation was made into the anterior chamber of the eye, and the calf slaughtered about six weeks later, "and found to be the subject of a pretty generalized tuberculosis. The eyeball was marked atrophied. After hardening, sections of it showed tuberculous lesions, especially on the iris, these lesions containing masses of Koch's bacilli. The sub-parotideal, cervical, mediastinal and bronchial lymphatic glands of the same side were tumefied and hypertrophied. On one section they showed miliary tubercles. The bacilli were recovered from the bronchial lymphatic glands, and sections of the various glands showed tuberculous lesions containing the bacilli. The lungs were affected on both sides, especially

at their apices. . .In addition, the lungs contained numerous miliary tubercles, and some grey fibrous tubercles of a larger size. Microscopic examination of these showed that they had the histology of tuberculous lesions and contained the specific bacilli." He concludes: "It follows from the experiments that it is difficult, but not impossible, to set up in the bovine species a generalized tuberculosis by means of pure cultures of bacilli obtained from the human subject. That the two diseases are identical still remains a firmly established truth, from which it follows that we must always take into account the danger of infection from the cow to man, which, in my opinion, is more likely to happen than the reciprocal infection. Contrary to Koch's opinion, the generally admitted higher virulence of bovine bacilli justifies us in exercising a strict supervision of the milk and flesh of tuberculous animals. The success of experimental infection depends in large measure on the degree of resistance offered by the animal, as Nocard has suggested, and as is demonstrated by the second experiment. It is desirable that numerous experiments may be carried out as soon as possible, and we do not doubt that the result will prove that the theory founded on the experiments of Shuetz and Koch is erroneous and the outcome of a premature conclusion."

In regard to the second point, Prof. Koch bases his conclusion largely on the alleged rarity of primary intestinal tuberculosis, and gives some statistics to support his claims. It is to regretted that he neglected to quote the figures given by a number of other pathologists of the highest standing who have found that primary tuberculosis of the intestinal tract is by no means a rare occurrence, especially in young children. Statistics on this point have recently been published by Dr. Leonard Pearson and myself in Bulletin No. 75, pages 62 and 63, Department of Agriculture; and further in a paper presented to the British Congress on Tuberculosis from the laboratory of the State Live Stock Sanitary Board of Pennsylvania, which is attached to the report.

Prof. Koch leaves out of consideration entirely, so far as we can judge from his published statements, the findings of all these observers, who as we said before have the highest standing in the scientific world. He ignores entirely the reported cases of infection through food, such as those mentioned by Prof. Nocard above, some of which "have almost the value of an experiment." He passes by the evidence afforded by such statistics as those collated by Thorne-Thorne, which show that while tuberculosis in all forms has diminished during the past forty-five years, the form known as phthisis reaching a diminution of sixty-six per cent., that *tabes mesenterica*, the intestinal tuberculosis of infants, has actually increased 27.7 per cent in children under one year of age. Admitting freely that statistics are not absolutely correct and making all possible allow-

ance for error, we still have a condition of things which cannot be explained except by the admission that milk from tubercular cows can and does produce a certain amount of tuberculosis in infants. Prof. Koch also falls into the error of claiming that only those cases which show primary intestinal tuberculosis can be attributed to food. Of late years it has been shown beyond doubt that the tonsils may act as the portal of entry for tuberculosis. Prof Hueppe, in a recent paper incited by Koch's announcement, speaks as follows on this point: "For this reason I have a suspicion that many forms of tuberculosis are at present erroneously attributed to respiration, whereas they ought to be attributed to infection from food, especially milk. In a given case it is difficult to prove this postmortem, but it will be sufficient to demonstrate that the cases of primary tuberculosis of the bowels certainly represent only a minimum portion of the cases in which infection has been conveyed by way of the mouth with food. The number of these cases occurring in children is by no means so small as Koch alleged. The number of the cases may be fairly reckoned as between 25 and 35 per cent. of all the deaths of children from tuberculosis. All cases of *tabes mesenterica* belong to this class, and according to Heller, tuberculosis of the mesenteric glands is present in almost a half of all the cases of tuberculosis affecting children. In adults, primary tuberculosis of the intestine is rarer, but it has been recognized with certainty even in them. The question, however, is one for public measures to be taken with regard to it. If cattle bacilli establish themselves in even only a few cases, they may open the way for a further extension of pathogenic organisms which will now more easily attach themselves to the human subject."

At the third general meeting, held at Queen's Hall, on Thursday afternoon, July 26, Prof. John McFadyean was the principal speaker, his address being an answer to Prof. Koch. It is given here in full:

TUBERCLE BACILLI IN COWS' MILK AS A POSSIBLE SOURCE TUBERCULOUS DISEASE IN MAN.

"As recently as a few days ago, when I was mentally arranging the material for the paper which I have now the great honor of submitting to this Congress, I was under the impression that it would not be necessary to formally prove that the term tuberculosis as it is now employed by medical men and veterinary surgeons relates to one and the same disease. I thought that I might ask my audience to accept it as proved, and generally admitted, that tuberculosis in man is caused by a single definite species of organism—the tubercle bacillus—that this organism is also the cause of the disease to which veterinary surgeons apply the term tuberculosis in the case of cattle and other domesticated species, and that there therefore existed a *prima facie* case against the germs formed in the bodies of tuberculous animals as a possible source of tuberculous disease in human beings.

To-day, however, the position of anyone who undertakes to discuss the inter-communicability of human and bovine tuberculosis is very different from what it would have been a week ago, for in the interval the greatest living authority on tuberculosis—the world-renowned discoverer of the tubercle bacillus, and the man to whom we are mainly indebted for our knowledge of the cause of tuberculosis—has declared his conviction that human and bovine tuberculosis are practically two distinct diseases. I do not know how far the reasons assigned by Dr. Koch for the opinion which he now holds on this question may have commended themselves to the members of this Congress, and I am overwhelmed at finding myself in a position which compels me to offer some criticism on the pronouncement of one, the latchet of whose shoes I am not worthy to unloose.

That bovine and human tuberculosis are indentical diseases was generally supposed to have been finally determined by Dr. Koch himself, when he discovered that the human and the bovine lesions contained bacilli that were identical in morphological, tinctorial, and cultural characters, and showed that the artificial cultures from both sources produced indistinguishable effects when they were employed to infect a variety of animals. The labors of hundreds of workers during the succeeding eighteen years produced nothing in serious

conflict with the conclusion that human and bovine tuberculosis were identical diseases, but they brought to light what appeared to be additional evidence of this identity, such as the discovery that tuberculin produced a specific reaction in tuberculous cattle, whether human or bovine bacilli had been employed in its preparation. In short, the identity of the bacilli from the two sources appeared to be as firmly established as any other generally accepted opinion regarding the identity or non-identity of bacteria associated with disease in more than one species of animal. Since it thus appeared to be proved that the only difference between human and bovine tubercle bacilli lay in their accidentally different position—one being parasitic in man and the other in cattle—it was natural to conclude that, when circumstances were favorable for the transference of bacilli from one species to the other, human tuberculosis might have an animal origin, and *vice versa*.

Opinions varied as to the frequency with which this transmission of tuberculosis from one species to the other occurred, but practically never within the last eighteen years regarding the possibility and probability of such reciprocal infection. What are the grounds upon which we are asked to discard convictions that appeared to rest on such a solid basis? I shall endeavor to state them briefly, as I understand Dr. Koch's train of reasoning.

(1) The bacilli found in cases of bovine tuberculosis are much more virulent for cattle and other domestic quadrupeds than the bacilli found in cases of human tuberculosis.

(2) This difference is so marked and so constant that it may be relied upon as a means of distinguishing the bacilli of bovine tuberculosis from those of the human disease, even assuming that the former may occasionally be found as a cause of disease in man.

(3) If bovine bacilli are capable of causing disease in man, there are abundant opportunities for the transference of the bacilli from the one species to the other, and cases of primary intestinal tuberculosis from the consumption of tuberculous milk ought to be of common occurrence. But post-mortem examination of human beings proves that cases of primary intestinal tuberculosis are extremely rare in man, and therefore it must be concluded that the human subject is immune against infection with the bovine bacilli, or is so slightly susceptible that it is not necessary to take any steps to counteract the risk of infection in this way.

Now, with the utmost diffidence I venture to submit that at least one of the premises contained in this argument is not well founded, that the others have little or no bearing on the question, and that there still remain reasonable grounds for regarding tuberculous cows' milk as distinctly dangerous to human beings.

It cannot be denied that what may be called bovine tubercle bacilli are as a rule distinctly more virulent for cattle and other domesticated animals than human bacilli, or that the results of experiments indicate that in natural circumstances there is little danger of cattle becoming infected from human beings. But it cannot be admitted that the low virulence of human bacilli for cattle proves, or even makes it probable, that bovine bacilli have only a feeble pathogenic power for man. That might have been held to be probable if it had been shown that bovine bacilli were very virulent only for cattle, but since it is well established that these bacilli are highly dangerous for such diverse species as the rabbit, horse, dog, pig and sheep, and in short, for almost every quadruped on which they have been tried, it appears to be highly probable that they are also dangerous to man. At any rate it is impossible to cite any ascertained fact relating to other bacterial diseases that makes the contrary conclusion probable. It is well known that the majority of disease-exciting bacteria are harmful to only one or two species, but all those that are common to all the domesticated animals are also pathogenic to man.

With regard to the view that the difference between human and bovine bacilli in respect of virulence for cattle is of such a fixed and constant character that it may be relied upon to distinguish the one from the other, it need only be said that that is very far from proved. It appears to be quite possible that what may be called the normal or average virulence of bovine bacilli for cattle may be reduced by passage through the human subject. Besides, there are very great differences in the virulence of tubercle bacilli found in animals of the same species, and if a low degree of virulence for cattle is to be taken as the distinguishing feature of human bacilli, there will be no difficulty in proving that the human disease is sometimes transmitted to the lower animals.

The third proposition in Dr. Koch's argument is the only one which is really germane to the point at issue, viz., that only cases of primary intestinal tuberculosis can possibly have had their origin in infected milk or meat, and that "such cases are extremely rare." Dr. Koch refers to several large series of post-mortem observations that appear to justify this statement, and adds that he could have cited many more pointing to the same conclusion. Now, if it were a fact that all the statistics relating to this point were unanimous, it would have to be admitted that primary intestinal tuberculosis is rare in the human subject, and that cases of infection through milk are still rarer, though even then it might be advisable to take measures to prevent the few cases. But the statistics are not by any means unanimous, and those that are likely to appeal with most force to the people in this country are not at all in accord with those quoted from Germany. During the last few years the evidence ob-

tainable from the post mortem records of two of the largest hospitals for children in this country have been analyzed with great care, in order to see what evidence they afforded as to the relative frequency of the different methods of infection in tuberculosis. In the case of the Hospital for Sick Children in Great Ormond Street this has been done by Dr. George Still, and in the case of the Royal Hospital for Sick Children in Edinburgh by Dr. Shennan. The conclusion at which Dr. Still arrived was that in 29.1 per cent. of the cases of tuberculosis in children, primarily infection appeared to have taken place through the intestine. That is very far from being an insignificant proportion, and it is a striking fact that Dr. Shennan arrived at an almost identical conclusion, and estimated that 28.1 per cent. of the cases of tuberculosis among children in Edinburgh are due to alimentary infection. There does not appear to be any ground for supposing that there is a large margin of error in these statistics, as the number of cases dealt with was considerable (547 in the two series), and in both series the post-mortem appearances were intrepreted in a way to which no exception can be taken. In face of these statistics it is not possible to assent to the statement that cases of primary tuberculosis of the alimentary canal are extremely rare. Precisely the contrary conclusion is the one that must in the meanwhile be drawn with regard to the state of affairs in this country, viz., that, at least in children, primary infection by way of the alimentary canal is comparatively common.

I therefore submit that there is still a strong *prima facie* case against animal tuberculosis as a possible source of human tuberculosis, and it becomes necessary to consider whether there are any data from which one may estimate the extent of the danger to which human beings are exposed through the occurrence of tubercle bacilli in milk.

The evidence in favor of the view that the ingestion of tuberculous milk is one of the causes of human tuberculosis includes a number of recorded cases in which the relationship of cause and effect appeared to be obvious. From the nature of the circumstances, evidence of this kind is very scanty, and it must be admitted that very few of the alleged examples are absolutely convincing. Tuberculosis is a disease that develops slowly, and assuming for the moment that tubercle bacilli do occur in milk, and are a cause of disease in persons consuming such milk, it is obvious that, as a rule, the very act by which the infection is brought about destroys the only direct evidence of cause and effect that exists.

One could only expect to be able to trace the disease to the milk when, after the onset of symptoms pointing to infection by way of the mouth, the cow from which the milk had been obtained was still available for examination. In practice this is rarely the case, and

it is therefore not surprising that medical literature contains very few specific instances of the infection of human beings with tuberculosis by means of milk. It is obvious, however, that the entire absence of evidence of this kind would in no way exonerate milk from the suspicion of being one of the causes of human tuberculosis.

We have already seen that, at least in this country, in a considerable number of cases of tuberculosis occurring in early life, the first seeds of the disease appear to have entered the body by way of the mouth. What proportion of these cases ought to be ascribed to tubercle-infected milk? It scarcely appears to be possible to give a very confident reply to this question, though some distinguished authorities have not hesitated to express the opinion that practically all the cases of primary intestinal tuberculosis occurring in childhood may be set down to this cause. The late Sir Richard Thorne-Thorne, in the Harben Lectures on the administrative control of tuberculosis, which he delivered in 1898, expressed his conviction that tuberculous milk was the main cause of *tabes mesenterica* in children, and he characterized the loss of child life from this cause as appalling. The evidence on which this formidable charge was laid against the milch cow was of the following nature. The Registrar General's Returns show that during the last fifty years there has been a marked decline in the death-rate from human phthisis, which is the form that tuberculosis generally takes when the bacilli are inhaled. On the other hand, during the same period there has been only a slight decline in the death rate at all ages from that form of tuberculosis which is ascribable to alimentary infection, and among children under one year of age there has been a notable increase in the mortality from that form of the disease. The decline in the death rate from phthisis is ascribable to the great improvements which have been effected during the last fifty years in the hygiene of human habitations, such as improvements in lighting, drainage, and ventilation. These, naturally, have not interfered with infection through milk, which has therefore remained unchecked, and in infants has even increased, because, during the last fifty years, cows' milk has entered more largely into the dietary of very young children.

There are several weak point in this argument. Perhaps the weakest of all is the assumption that the deaths certified under the head of *tabes mesenterica* correspond closely with those which the pathologist would classify as cases of primary alimentary infection. It is scarcely possible to doubt that the term *tabes mesenterica* in the Registrar-General's Returns covers a heterogeneous collection of cases, of which the majority may not be cases of tuberculosis at all. But even if it is agreed to accept all the cases registered under the head of *tabes mesenterica* as instances of primary alimentary in-

fection, the figures found in the Registrar-General's Returns do not support the contention that milk is responsible for all the cases of *tabes*. It is true that they indicate an increase in the death rate from alimentary tuberculosis among children under twelve months old, but, on the other hand, there appears to have been a considerable decline in the death rate from the same cause at all ages between one and five years. Now, if tuberculous milk were a frequent cause of tuberculosis, one would not have expected the death rate from that cause to decline among children between one and five years of age, for there is no reason to suppose that there has been any decline in the use of cows' milk in the feeding of children at that age during the last fifty years. The fact appears to be that the Registrar-General's Returns do not afford much trustworthy information with regard to the number of cases of primary alimentary tuberculosis, and are absolutely worthless as an indication of the extent to which human beings are infected by means of milk.

There is another direction in which one may turn for evidence on this point. We cannot with any pretence to accuracy ascertain the number of persons that annually become infected by milk, but we may be able to form some estimate of the existing danger in this connection by collecting information as to the frequency with which milk contains tubercle bacilli. We know that about thirty per cent. of all the cows giving milk in this country are tuberculous in some degree. This statement no doubt indicates a deplorable state of affairs, but in the present connection it is not quite so alarming as it at first sight appears. Fortunately not every cow that is tuberculous gives milk containing tubercle bacilli. It is true that opinions with regard to this point are not absolutely unanimous, but there is ample evidence to justify the assertion that as a rule the milk is not dangerous until the udder itself becomes diseased. The experiments pointing to an opposite conclusion form only a small minority, and the results obtained in most of them were probably due to carelessness on the part of the experimenter. In a few of the cases in which the milk of an apparently healthy udder was found to be infective, it is probable that the gland tissue was in reality diseased, though not to an extent discoverable without microscopic examination. The important question, therefore, is not what proportion of milch cows are tuberculous, but what proportion of them have tuberculous udders. Some authorities have estimated this to be as high as ten per cent., but the proportion is certainly much less than that in Great Britain. My own experience leads me to think that about two per cent. of the cows in the milking herds in this country are thus affected. Now, the milk secreted by a tuberculous udder always contains tubercle bacilli, and it sometimes contains enormous numbers of them, and when these facts are apprehended one begins

to realize the seriousness of the danger to which, in the present state of affairs, those who drink uncooked milk are exposed.

But there are one or two considerations that make the danger greater than the mere statement of the number of cows affected would at first sight indicate. In the first place, the udder disease is not attended by any pain or tenderness in milking, and the milk for a considerable time after the udder has become manifestly diseased may appear quite wholesome, though in reality it is charged with the germs of tuberculosis. It therefore often happens that the gravity of the condition is not realized by the milker or the owner of the cow, and the milk continues to be sold for human consumption. There is scarcely any room for doubt that if it were sold and consumed unmixed with other milk, some of the persons partaking of it would become infected. In practice it is usually mixed with the milk from other cows that have healthy udders, and thus the germs are distributed among a larger number of persons. Even tuberculous milk that has been thus much diluted may prove infective, but the danger to the individual consumer is in inverse proportion to the degree of dilution.

Since about one cow in fifty is the subject of tuberculosis of the udder, and the average number of cows in the milking herds of this country is less than fifty, it follows that the majority of dairies and farms supply milk that is free from tubercle bacilli, or at least does not contain any derived from this source. On the other hand, when the infected material is present, it operates with the greatest intensity in the milk of single cows, and in the mixed milk from small herds.

It must be added that tuberculous disease of the udder is not the only source of tubercle bacilli found in milk. A great deal of the milk in the market contains a considerable quantity of dust and dirt, most of which comes from the cow's udder and the hands of the milker, and part from the dust of the air of the cowshed. When thirty per cent. of the cows in a byre are tuberculous, the dirt in that building, and the atmosphere in it, are almost certain to contain tubercle bacilli, and some of these are very likely to find their way into the milk. The more dirt milk contains, the greater is the chance that tubercle bacilli from that source may be present.

What has been said with regard to the extent of the danger to which the public are exposed through the sale of milk containing tubercle bacilli may be summed up as follows:—The danger cannot be defined by stating how many persons are thus infected annually, or what fraction the person thus infected form of the total number who contract tuberculosis in the course of a year. At the same time, it is impossible to doubt that the danger is a very real one, since at

the present time milk is a vehicle by which tubercle bacilli are often introduced into the bodies of human being."

Means of Averting the Danger.

"The ideal method of counteracting this source of human disease would be to stamp out bovine tuberculosis, or to prevent the sale of milk from every cow that is tuberculous. Unfortunately, it must be admitted that at present that is unattainable. At the present time probably not less than thirty per cent. of all the breeding and milking cattle in this country are in some degree affected with tuberculosis, and to urge that the disease should be attacked on the lines adopted in dealing with cattle plague and pleuro-pneumonia, is an effectual method of preventing any Government from touching the subject. But, although the complete and rapid extermination of the disease is impossible, it does not follow that nothing can be done, or ought to be done, in the way of prevention. The disease has attained to its present alarming proportions simply because, until quite recently, altogether erroneous notions were held regarding its cause, and because there has hitherto been the most absolute neglect of the precautions necessary for its prevention. The greatest obstacle to successful action against tuberculosis, whether in man or animals, is the ignorance of the laity regarding the cause of the disease. The immense majority of cattle owners are not yet convinced that contagion is the only cause of tuberculosis, and very few of them have yet made the slightest effort to check the spread of the disease. As a rule, cows and other cattle visibly ill from tuberculosis are still left alive and in close association with their fellows, although the lowest grade of common sense and prudence would suggest that such animals ought to be promptly killed, or, at least, isolated. It is not want of common sense, nor is it mainly lack of means that is responsible for this inaction; it is simply a want of conviction on the part of cattle owners that tuberculous animals are dangerous to their companions.

The first thing necessary in this connection is education of the people regarding the nature of the disease. It is necessary, because in this country, where Parliament never moves except by the force of public opinion, the legislative action required will not be taken unless the people are satisfied of its wisdom, and also because even the most drastic sanitary measures enforced by the law are likely to fail if they are not supplemented by the intelligent co-operation of the people. The National Asociation for the Prevention of Consumption and the Royal Agricultural Society have been endeavoring to disseminate sound views regarding the cause of bovine tuberculosis among farmers and others, but much remains to be done in this direction. But it is not reasonable to ask that things should

be left as they are until the education of the farmer in the matter of tuberculosis has been finished. If there are any practicable and reasonable measures by which, figuratively speaking, the flow of tubercle bacilli from tuberculous cows to healthy human beings can be stopped or impeded, they ought to be immediately enforced.

As soon as the valuable diagnostic properties of tuberculin had been proved by experience, it occurred to a good many people that its assistance ought to be called in in order to exclude tuberculous cows from milking herds. In other words, it was thought that although it might not be practicable to insist upon the application of the tuberculin test to all infected herds, and to compel the isolation or slaughter of all cattle thus found to be infected, it might still be possible to require that only cows found to be free from the disease by the application of the test should be kept for milch purposes. I doubt whether anyone who is well acquainted with the circumstances of the case now believes this practicable. Here, again, the fact that one-third of the cows now giving milk are tuberculous is an insurmountable obstacle. The cost of carrying out the tuberculin test several times annually in all the milking herds in this country would be enormous, and the exclusion of all reacting cows from such herds would seriously disorganize cattle breeding as well as milk production. Moreover, to rely blindly on the tuberculin test, and to pronounce the milk of every cow that does not react to it free from tubercle bacilli, would be very unsafe. The test is recognized to be one of great value, but it is not infallible. Rather serious defects in connection with it are:—(1) That for a period after infection—a period that is sometimes very considerable—an animal will not react; (2) that in some advanced cases of tuberculosis no distinct reaction is obtainable; and (3) that in a considerable proportion of cases a second reaction is not obtainable for some days or weeks after the first. It is therefore clear that if we wish to exclude the milk of tuberculous cows, or if the object is the more restricted one of preventing the sale of milk from tuberculous udders, some system of inspection is necessary. This was the conclusion at which the Second Royal Commisison on Tuberculosis arrived. We have already seen that whatever danger attaches to milk comes mainly from the cows with tuberculosis of the udder, and the public health would be almost entirely safeguarded from this danger if we could exclude such animals from our dairies. Periodic examination by competent inspectors would go a long way to securing this object, but the inspection would require to be at rather short intervals, for a tuberculosis of the udder may come into existence and attain most dangerous dimensions in a period of a few weeks. The more frequent the inspection the better, but, of course, this means a great deal of expense.

If every town and rural district produced its own milk, it would be a comparatively simple problem to organize and carry out a fairly efficient system of inspection of milch cows; but as the law at present stands, the majority of the population cannot obtain this safeguard. With the exception of Glasgow, Manchester, and a few other places, a local authority has no power to inspect cows outside its own district, and the helpless position in which this state of the law leaves the inhabitants of London and other large towns is obvious. If cows of which the milk is sold for human food had everywhere to be submitted to periodic inspection, such inspection would naturally be undertaken by the various local authorities, each of which would supervise the cows and cowsheds in its own district; but the compulsory inspection of all the milch cows in the country would be a very large undertaking, and perhaps it would be premature to press for it. In the meantime, a good case can be made out for making general the special powers relating to inspection of cows in outside districts which a few fortunate cities have acquired by special acts of Parliament. This also was one of the directions in which the members of the Second Royal Commission on Tuberculosis considered immediate action to be necessary.

There remain for consideration some other safeguards which would doubtless be less effective than those just discussed, but which, unlike these, would not be difficult to enforce, viz:—(1) Compulsory notification of udder disease and of any symptoms of tuberculosis in milch cows, with, of course, the power to inflict a considerable fine for not reporting; and (2) the interdiction of the sale of milk from any cow suffering from tuberculous disease of the udder, or exhibiting clinical signs of tuberculosis. Against the demand for the amendment of the existing law to the extent of granting the public these very reasonable safeguards against infection through milk, it cannot be urged that they would be very expensive, or that they would press harshly on private interests. The present state of the law, or rather the almost entire absence of any law, dealing with tuberculous udder disease in cows, is a scandal and a reproach to civilization. It scarcely sounds credible, but it is a fact, that the owner of a cow in the most advanced state of tuberculosis, and exhibiting the most manifest signs of udder disease, may sell that cow's milk for human food as long as the sale has not been specially interdicted on the certificate of a veterinary surgeon, and no penalty attaches to this crime of deliberately or carelessly placing on the market a food material charged with the germs of a dangerous disease.

In the interests of public health, the sale of milk from tuberculous udders, and from cows that are obviously tuberculous in any part of the body, must be stopped, and it must be declared illegal to keep

such animals alive. There need be no hesitation in pressing for this reform, because the measures demanded are in the interests of the owners of cattle, and would be advisable even if it were established that bovine tuberculosis is not transmissible to man. There is no dispute as to the danger of visibly tuberculous animals to others of their own species, and it is the very reverse of a hardship to the owner of such animals to insist on their being slaughtered.

It would probably be regarded as a serious omission if I did not refer to one other method of counteracting whatever danger at present attaches to impure milk as a cause of human tuberculosis. No matter how highly charged milk may be with tubercle bacilli, it can be deprived of all danger from that source by raising it to the temperature known to be fatal to these germs. Less than the boiling temperature (212 degrees Fahrenheit) suffices for this purpose; but, unfortunately, the lowest temperature that can be relied upon imparts to the milk a flavor that many people find distasteful. That objection does not hold good in the case of infants and young children, and the custom of boiling or steaming the nursery milk for a few minutes cannot be made too general. But while abstinence from uncooked milk is a sure way of avoiding infection with bacilli present in that article of food, it cannot for a moment be admitted that this absolves public health authorities from all concern with the subject. Arsenical beer may be made harmless by adding the proper antidote before drinking it, but the most courageous brewer would not plead this as an excuse for selling the impure article.

In conclusion, I would venture to express the earnest hope that the Congress will not endorse the view that it is inadvisable to take any measures to prevent the transmission of tuberculosis from the lower animals to human beings. To justify the introduction of measures to that end it is not necessary to contend that this is a common method of infection, or that the danger arising from milk can for a moment be compared with that present in human sputum. The inhalation of tubercle bacilli expelled from the bodies of human patients is doubtless the great cause of human tuberculosis, and every practicable means of preventing infection in that way ought to be employed; but, at the same time, we ought not to concede to the milkmen the right to sell us tubercle bacilli, even if we were assured that—like Dr. Koch's experimental pigs—we had nothing to fear beyond the development of 'little nodules here and there in the lymphatic glands' of our necks and a 'few grey tubercles' in our lungs."

RESOLUTIONS ADOPTED BY THE BRITISH CONGRESS ON TUBERCULOSIS.

1. That tuberculous sputum is the main agent for the conveyance of the virus of tuberculosis from man to man and that indiscriminate spitting should therefore be suppressed.

2. That it is the opinion of this Congress that all public hospitals and dispensaries should present every out-patient suffering from phthisis with a leaflet containing instructions with regard to the prevention of consumption and should supply and insist on the proper use of a pocket spittoon.

3. That the voluntary notification of cases of phthisis attended with tuberculous expectoration and the increased preventive action which it has rendered practicable has been attended by a promising measure of success and that the extension of notification should be encouraged in all districts in which efficient sanitary administration renders it possible to adopt the consequential measures.

4. That the provision of sanatoria is an indispensable part of the measures necessary for the diminution of tuberculosis.

5. That in the opinion of this Congress and in the light of the work that has been presented at its sittings, medical officers of health should continue to use all the powers at their disposal and relax no effort to prevent the spread of tuberculosis by milk and meat.

6. That in view of the doubts thrown on the identity of human and bovine tuberculosis, it is expedient that the Government be approached and requested to institute an immediate inquiry into this question, which is of vital importance to the public health and of great consequence to the agricultural industry.

7. That the educational work of the great national societies for the prevention of tuberculosis is deserving of every encouragement and support. It is through their agency that a rational public opinion may be formed, the duties of public health officers made easier of performance and such local and State legislation as may be requisite called into existence.

8. That this Congress is of the opinion that a permanent national committee should be appointed: (a) To collect evidence and report on the measures that have been adopted for the prevention of tuberculosis in different countries; (b) to publish a proper statement of these measures; (c) to keep and publish periodically a record of scientific research in relation to tuberculosis; and (d) to consider and recom-

mend measures of prevention. This Congress is further of the opinion that such a committee should consist of representatives to be elected by the great national societies formed for the suppression of tuberculosis and also representatives nominated by various Governments. It is further of the opinion that all international committees and great national societies whose object is the prevention of tuberculosis should be asked to co-operate.

9. That, in the opinion of this Congress, overcrowding, defective ventilation, damp, and generally unsanitary conditions in the houses of the working classes diminish the chance of curing consumption and aid in predisposing to and spreading the disease.

10. That while recognizing the great importance of sanatoria in combating tuberculosis in every country, the attention of Governments should be directed towards informing charitable and philanthropic individuals and societies of the necessity for anti-tuberculous dispensaries as the best means of checking tuberculous disease amongst the industrial and indigent classes.

11. That the following question be submitted to the consideration of the next Congress:—The constitutional conditions of the individual which predispose to tuberculosis and the means whereby they can be modified.

The resolutions adopted by the Congress at its final session, and which have been given above, indicate well the tendency of the discussions as well as their results, and the balance of scientific opinion. It will be observed, that with the exception of Prof. Koch's views regarding the absence of danger to man from bovine tuberculosis, nothing particularly new was brought forward, and there was practical unanimity of opinion concerning all points of public interest.

PRACTICAL EXPERIMENTS IN THE RESTORATION OF WORN OUT SOILS.

BY R. F. SCHWARZ, *Analomink, Monroe County.*

We have all heard, and some of us have seen a few of them, of the abandoned farms of New England; farms, which, while in times past their owners were enabled from the proceeds of their product to bring up generations of families in comparative comfort, have so run down or because of the exhaustion or rather ill treatment of their soil have become so unfertile that their last owners, unable longer to make them pay, have forsaken them for the poorhouse or for some other pursuit.

Pennsylvania, as well as New England, though not to as great an extent, has her abandoned farms, and has a still greater number of farms which ought to be and will be abandoned unless their owners pursue a more generous and intelligent course in the treatment of their soil. The lesson must be learned that you can not take something from nothing and that no matter how deep the well, so soon as you take from it and keep on taking from it water beyond its capacity to refill, so soon is that well bound to me exhausted. We in the eastern States must learn that lesson now or in fact should have learned it before now, but even the tillers of the seemingly exhaust-proof rich soil of the western prairies will in time be forced to learn it.

Analysis of average soils shows us that there are stored in the top twelve inches of earth sufficient of nitrogen, of phosphoric acid and of potash to last for hundreds and hundreds of years; the sole question being as to how to make these valuable and necessary ingredients of plant growth, which live there in a temporarily insoluble state, available as plant food.

While others have succeeded as well as have I, in restoring lands of this description to a fertile condition, I may do some good by giving my experience in this line. I bought in 1888 a farm of 38 acres, which had been cropped for many years by its previous owner who had raised and brought up on it quite a large family of boys and girls. After his death, the children having all moved away and settled elsewhere the farm was for eight or nine years rented out on

shares, which means that it was constantly cropped but that no fertilizing value or material was put back on the soil. It proved so unproductive that at the end of that time no one would further waste time and effort in the attempt to raise crops which would not even pay for the labor. It was then rented out for pasture, but the year before I bought it the starved appearance and condition of the two cows pasturing on it led their owner to move them to more congenial climes and the farm became a burden on the estate which owned it, for the taxes had to be paid from other resources or incomes than those of the farm. The land was considered so poor that as my friend Seeds puts it, you could not even raise a disturbance on it.

At this time I bought it because I needed more land; but the circumstances and conditions of my need were such that I had to make up my mind to at once utilize the land for the raising of crops and at the same time to bring it up to as nearly its virgin productiveness as I could. It was impossible for me to apply manure as I had use for every pound of manure I could make or buy on my market garden of fifteen acres, and as a matter of fact I have never put even a single load of manure on this farm during the thirteen years of my ownership and yet, while I have continuously by force of circumstances cropped every field every year, these thirty-eight acres are to-day in a condition of fertility not equaled by any other land for miles around.

I knew from trips through the south that but comparatively small portions of the large plantations there in vogue were being cultivated, and that their owners, too indolent to have manure hauled out on their extensive fields, and too much in need of the money produced by their crops to spend it on fertilizers, depended for fertility entirely on the natural grasses which would overrun the idle fields and being left undisturbed, would after four or five years have quite a coating and quite a root system of vegetable matter, which, when plowed under, would so act on the soil by reason of the humic acid created as to bring the soil to produce quite fair crops for the labor expended. These fields would be cropped for two or sometimes three years and then again left lying idle for the next four or five years, while other grass grown fields were given their chance to furnish the needed crops. I reasoned that after all, all soil had been made fertile by decayed vegetable matter and that if I could produce this vegetable matter on my fields between crops and plow it under year after year I should soon be able to restore my farm to proper fertility and condition.

While I believe that this process could be followed and success achieved in time without the use of fertilizers, my needs were such that in order to immediately use my land and to save time I thought it best and cheapest in the end, to resort to the use of fertilizers.

The soil is a slatey shale underlaid by a clayey sub-soil and in three of the fields by hardpan, which in its turn is underlaid by a sandy gravel. One of the hard pan-fields I tile-drained at very considerable expense, which great outlay deterred me from applying this expensive remedy to the others. You will see later what effect my method of renovation has had on these two fields which remained without tile drains.

The first spring I took in hand four of the seven fields, putting two in potatoes and two in early corn, all with a generous application of fertilizer. I may here say that I consider fertilizers as only a means to the end and that end is to be able to do without them. The crops realized were not great, but still paid fairly for the investment.

Just as soon as the crops were gathered during late summer and fall these fields were plowed and sowed to rye. I used rye because I then knew of no other plant which could be grown for my purpose at that time of year. The rye, having been sown reasonably early and finding, I supposed, some of the unused fertilizer as food, grew well and was plowed under the next spring at various stages of growth and all four fields again put in crops, the two potato fields being put to corn and the two corn fields to potatoes, using a reduced amount of fertilizer. The other three fields were plowed and planted that spring, two with corn and one with potatoes and the same process of sowing and plowing in rye was followed that fall and the next spring.

The agricultural press of the time began to tell us of the great work crimson clover was doing in the reclaiming of soils in Virginia and Maryland, but no one in my latitude then supposed that it could be grown successfully much above the Mason and Dixon line, and that we should ever be able to use it for the purpose of drawing the free nitrogen of our atmosphere from the boundless sky and store it in the shape of globules on its roots for the sustenance of crops to follow, besides giving us in its rapid and I may say rank growth the largest quantity of that humus we so much needed. Of cow peas I knew nothing nor did I then know of an early variety of soja beans, which has been introduced since. So the rye was all I had and I considered that it was not till 1893 or '94, I think, that at a farmers institute in Lackawanna county I heard Mr. George Powell, of Ghent, N. Y., tell of his success in growing crimson clover more than a hundred and fifty miles north of my county (Monroe). I at once concluded that if he could grow it I could, and in July of that year I sowed it in my corn fields. This first attempt proved a failure for two reasons: The one was the fact that I had sown it on top of the freshly stirred soil at the last cultivation of corn and the other I have ever since thought was that I obtained Maryland seed, or in other words, seed which had not been properly acclimated.

After another talk with Mr. Powell, that fall I tried again and had the satisfaction of complete success in four of my fields. These four crimson clover fields, the first in my county, were during the next spring the admiration and wonder of my neighbors for many miles and your then colleague on this Board, Mr. Randall Bisbing, came seven miles and walked with me through clover reaching considerably above our knees. But a few years before to the certain knowledge of all these people this farm had been considered absolutely worn out and yet here I could show them clover fields such as the older men had not seen since their boyhood and this in face of the fact that hardly more than a half dozen farmers in the county could succeed in raising red clover excepting in well manured fields.

These four fields were plowed under that spring and I have since followed this practice year after year where possible. Where, because of the limit of time in which crimson clover must be sown, I am unable to get it in, I have used cow peas and in one case soja beans, or where too late for these, for they should with us be plowed under after the first nipping frost, I have continued to sow rye, combined however with "sand or winter vetches." This idea I got from Europe from a friend to whom I wrote. The vetch is a plant belonging to the leguminous species, the same family to which clover belongs; it is of a viney trailing growth and the rye is added simply to give support to the vining vetch plant. As a nitrogen gatherer I consider the vetch superior to even crimson clover; the globules on its roots are almost a continuation of small cockscombs and the quantity of nitrogen stored therefore supposedly greater; but as a producer of vegetable matter simply it is inferior to crimson clover, as neither its roots nor its top have the branching habit of the clovers. Nevertheless it is extremely and equally valuable because it can be sown so late in the season and will not winter-kill. Wherever rye or wheat grow there will vetches grow, and whenever rye or wheat can be sown, with us as late as October 15, their can vetches be sown successfully.

Keep in mind all this time that with the exception of the first year when but four fields were in crop, I have never in all these years lost a year's crop from any of these seven fields, two of which are in raspberries and blackberries sown between the rows every year with crimson clover or with cow peas, either of them plowed in in proper time. Keep also in mind that while I was at first obliged to use complete fertilizers containing the expensive item of nitrogen for several years past I have been able to dispense with this expensive ingredient and have used only potash and phosphoric acid. Had I known of crimson clover and cow peas and vetches four or five years sooner I should have saved on the purchase of nitrogen just that much longer. I consider that my crops, if in the early stages of the

experiment they merely paid the expense of their growth, have since amply paid me for the work and have paid a very fair interest on the investment. That being the case it remains to be seen what this method of restoring worn out soils has done for my land.

At the time of purchase, on plowing I found a hard top soil of about three inches, which fell from the plowshare dead and lifeless when first tilled, below that was a yellowish poor looking subsoil. In contrast to-day we plow over eight inches deep without striking this yellow substance, and a rich darkish soil falls from our mould boards and quivers as though alive quite a while after the plow has passed.

In the two fields underlaid by hard pan the process has done even more; I cannot explain scientifically, but suppose that the constant work of the clover or vetch-roots has little by little penetrated the strata or hard pan and has thus opened pores for the escape of water. Certain it is that the symptoms previously apparent after a heavy rain, when I would sink half up to my knees in the soil, have disappeared and the soil is evidently well drained and seems to enjoy full capillary action.

More than this, all the land from being a soil previously most injuriously affected by droughth has become almost droughth-proof, evidently because the humus-filled soiled is able to retain and hold immense quantities of moisture which previously simply leached or drained off. For an example:

One of the fields was in the fall of 1899 sown to rye, because it was too late to put in anything else, and I discovered also too late that all my vetch seed had been sown. Last spring one of my men persuaded me, because of our usual difficulty to get enough straw by purchase, to let the rye stand. I disliked doing this, but on finding that I could rent a field from a neighbor to take the place of this rye field for my crops, I finally yielded but had red clover sown in the rye with little faith however in our ability to get a stand.

I think you all know that our section of the State, the northestern section, never before experienced so severe and so lasting a droughth as last year brought us, and yet this field of rye made a most wonderful growth, not only in straw which reached over my head, but also in the development of the heads. When cut I had it immediately hauled to a neighbor who threshes as a business, and he told me that this rye turned out one-third more to the 100 sheaves than the best he had ever threshed before.

After the rye was off I had no time to go over to the farm, but, feeling that I ought to return something to the soil for what it had given me without any fertilizer whatever, I sent one of my men with a team and a bag of cowpeas to plow the field and sow it, the peas to

be plowed under in the fall. Imagine my surprise when he came back after a little while and asked me if I meant him to plow under the clover. I had forgotten all about the clover and never supposed that it could make a stand in such a droughth. I went over at once and there found a wonderful even stand of thrifty red clover, the first on that farm in twenty five years; last fall, which of course was late, some time before winter set in a friend of mine walking over the field with me, called me extravagant because I did not cut the clover for hay. It was then a solid mass almost knee high.

Now this is the simple story of a method which anybody can use. Some labor, a little seed and, if time is more valuable than money, some fertilizer to start with will make a rich field out of the poorest land in a few years time. Any owner of a worn out farm, not being obliged, as I was, to crop his fields every year, ought by this method to be able to restore his entire farm to paying fertility. If this process of returning a plentiful supply of humus to the soil after taking off crops were generally employed by our farmers we should never hear of abandoned farms and but little of exhausted or worn out soils in Pennsylvania.

METHODS OF STEER-FEEDING.

Co-operative Experiment by the Pennsylvania State Department of Agriculture and the Pennsylvania Agricultural Experiment Station.

UNDER THE IMMEDIATE SUPERVISION OF G. C. WATSON AND A. K. RISSER, STATE COLLEGE, PA.

Bulletin No. 67, published in August, 1900, gives an account of an experiment which was designed to test various methods of feeding steers. This experiment has been repeated in all essentials and the results described in the following pages. It is recognized that one trial, with a comparatively small number of animals, is not sufficient to determine the many questions involved in such a test. Therefore, the experiment herein described was designed to be largely a repetition of the one made the year previous, in order that the results of the two may be compared and that somewhat more reliable data may be secured for the information of those who are particularly interested in converting the roughage of the farm and commercial stock foods into the more valuable product of prime beef. The narrow margin of profit in feeding steers, which have been reared in other localities, compels the feeders to study closely the strictest economy as to the outlay of labor and money, and to note tendencies even before results are obtained. One object of the trial was to determine as far as possible the comparative cost as well as the efficiency of various methods of feeding.

Plan of the Experiment.

The experiment was devised to test certain practical methods of confining fattening steers as well as to test the usefulness of automatic watering devices for fattening animals as steers are usually confined throughout Pennsylvania. The experiment was designed to determine, if possible:

(1) The effect of different methods of supplying drinking water;

(2) The effect of different methods of confining fattening animals;

(3) The amount of labor required to care for animals under these various conditions.

Experiment No. 2. (*Dec. 5, 1900, March 19, 1901.*)

In order to make this test as satisfactory as possible under practical conditions, space was set aside in the basement of the college barn in a similar manner to that described in Bulletin No. 67. Three lots of steers were used in this experiment. One lot, Lot No. 1, consisting of ten animals, was placed in a large box stall 20x21½ feet in area, which is exactly the same space that the ten steers would have occupied had they been placed in stalls; that is, the stalls were removed and the space occupied by the stalls enclosed by high board partitions, which made, to all intents and purposes, a large box stall. On account of the lack of space, Lots Nos. 2 and 3 consisted of but six steers each. These were kept in stalls adjoining the box stall. Lot No. 1 (in the box stall) was supplied with water furnished by means of automatic watering basins, in which water was kept before the animals all of the time except when the water was withheld for a short time previous to the weighing periods. Lot No. 2, which consisted of six animals, was supplied with water by means of automatic watering basins similar to Lot No. 1. Lot No. 3 consisted of six animals, and was placed in stalls in a similar manner to Lot No. 2, with the exception that the steers were turned out once each day for an hour or two in a large yard adjoining the basement, where they were permitted to drink in common from a large watering trough. The animals of Lots Nos. 1 and 2 were not removed from the pen and stalls except as it was desired to weigh them on alternate weeks.

The Animals.

The steers used in this experiment were purchased at the stock yards in Pittsburg, November 21, 1900, by Mr. William C. Patterson, the Farm Superintendent, and the writer. In this connection, it should be stated that Mr. Patterson has successfully fattened one or more carloads of steers on the college farm each year for many years, and is recognized as an expert buyer. The steers selected were dehorned grade Shorthorn steers raised in eastern Ohio, and were carefully selected as to size, age and quality, so far as outward appearance would indicate. The steers were sorted into lots soon after they were purchased and were confined in the pens and stalls until the experiment was begun. The steers were sorted with great care in order that the lots might be as uniform as possible and at the same time have nearly the same average weight. These steers were tame and considerably above the

average as to quality and general appearance. They had been given considerable grain and were "well started." In fact, some butchers would have selected a few for slaughter. In the following table (page 10) is given the weights of each steer at the beginning and close of the experiment, as well as at each weighing period on alternate weeks during the period of feeding.

Rations Fed.

Each lot was fed a grain ration consisting of nine parts of corn meal and one part of wheat bran by weight, in such quantities as would be readily consumed. The judgment of an experienced feeder was relied upon to determine the amount that should be given from day to day. An accurate account was kept of the total amount of grain consumed by each lot, but no effort was made to determine the amount of food consumed each day. The grain for each lot was weighed out weekly and placed in a bin. The feeder having access to this bin fed each lot the necessary amount. At the end of the week, that remaining in the bin was weighed and deducted from the amount previously weighed out. In a similar manner an account was kept of the hay and corn stover consumed by each lot of steers. The hay consumed by the three lots was of good and uniform quality, largely timothy with a little clover. The corn stover was well cured and shredded. The hay and corn stover were placed in large sacks and weighed and taken from the sacks and placed in the mangers as required. The unconsumed portions were weighed back and deducted from the total amount offered them, the difference giving the amount consumed. As the refuse was frequently small, it was not weighed back until a considerable amount had accumulated; that is, the unconsumed hay and stover were removed each day and kept until a considerable amount had accumulated, when the whole was weighed and sampled. The following table gives the amount of food consumed weekly by each lot:

Food Consumed.

Date.	Lot I.			Lot II.			Lot III.		
	Hay.	Fodder.	Grain.	Hay.	Fodder.	Grain.	Hay.	Fodder.	Grain.
For Week Ending:									
December 13, 1900,	525	274.5	1,031.0	309.5	112.5	532.5	299.0	89	531.5
December 20, 1900,	509	238.0	1,008.0	302.0	75	539.5	283.0	37	557.5
December 27, 1900,	529	235.0	989.5	293.5	97	638.5	265.5	62	484.5
January 3, 1901,	525	210.0	970.0	288.0	78.5	633.5	289.0	54	600.5
January 10, 1901,	518.5	209.5	1,026.0	293.0	81	666.0	264.5	46	584.5
January 17, 1901,	525	177.0	1,090.0	288.0	62	729.0	255	34	575.5
January 24, 1901,	525	207.0	1,137.0	276.5	63	769.0	265.5	55	660.5
January 31, 1901,	525	199.5	1,219.0	301.5	91	789.5	272	21	753.5
February 7, 1901,	525	190.0	1,253.5	291.5	60.5	820.0	262	40	808.0
February 14, 1901,	525	206.0	1,369.5	301.5	63.5	836.0	292	36.5	779.0
February 21, 1901,	525	182.0	1,330.5	297.5	97	746.0	287	66	675.0
February 28, 1901,	525	211.0	1,449.5	300.0	113.5	758.5	282.5	93	774.0
March 27, 1901,	525	197.5	1,438.0	299.0	192.5	780.5	281	120	685.0
March 14, 1901,	519	216	1,338.5	290.0	119.5	758.0	272	96.5	780.0
March 20, 1901,	440	176	1,265.0	235.0	196.0	637.0	228	86.5	648.0
Total,	7,761.5	3,132.0	17,915.0	4,369.5	1,286.5	10,649.5	4,098.0	936.5	9,896.5
Average per head,	776.15	313.20	1,791.50	728.25	214.4	1,774.7	683.0	156.08	1,649.4

It was observed early in the experiment that Lot No. 3 was not consuming so much corn stover per thousand pounds of live weight of animal as either of the other two lots, yet it did not seem advisable at that time to change the amount given them. Thus, it was noticed that the steers that were turned out to water once a day corresponded quite closely in the consumption of corn stover to a similar lot of the previous experiment. The amount of hay and stover offered each lot and the amount refused are shown below, as well as a similar statement of the previous experiment.

Amounts of Hay and Stover Consumed by each Animal of each Lot.

	Hay offered.	Hay refused.	Hay consumed.	Stover offered.	Stover refused.	Stover consumed.
Experiment No. 1, 1899-1900:						
Lot I,	1,107	11	1,096	503	189	314
	1,091	26	1,065	503	215	288
	1,068	52	1,016	501	321	180
Experiment No. 2, 1900-1901:						
Lot I,	780	4	776	338	75	313
	780	51.5	728.5	393	178	215
	780	97	683	393	236.5	156.5

The animals that were turned out in the yard to water each day did not consume roughage as readily as those that were supplied with water from automatic watering basins.

It will be noticed that Lots Nos. 1 and 2 refused less hay and stover than Lot No. 3; also, that in both experiments Lot No. 1 refused the least hay and stover, that Lot No. 2 refused more and Lot No. 3 refused the most in both instances. In all cases the hay and stover that were not consumed were removed from the mangers and weighed. Practically none was thrown from the mangers and wasted by the steers. It is true that in 1899 and 1900, the three lots were not given quite the same amounts of hay and stover, although the difference in the amounts given was not great, and it should be noticed that the lots that consumed the least were given the least.

Weights and Gains.

In the case of nearly every animal, the increase in weight throughout the experiment showed considerable variation, as seen in the table of weights. This is no doubt due chiefly to the amount of water retained in the system at the time of weighing. In each case, the weight was taken at nine o'clock A. M., and after the water had been withheld for about sixteen hours.

Weights of the Steers at each Weighing.

Number.	Weight at beginning.	Second week.	Fourth week.	Sixth week.	Eighth week.	Tenth week.	Twelfth week.	Fourteenth week.	Final weight.
Lot I.									
[illegible]	959	980.0	1.005.0	1,013.0	1,047.0	1,171.0	1,094.0	1,110.0	1,122.5
[illegible]	1,013	1,052.5	1,080.0	1,127.0	1,173.0	1,211.0	1,200.0	1,232.5	1.242.5
[illegible]	1,065	1,032.0	1,075.0	1,090.0	1,135.0	1,175.0	1,210.0	1,240.0	1,249.0
[illegible]	1,015	1,032.0	967.5	1,098.0	1,117.5	1,160.0	1,191.0	1,202.5	1,216.0
67,	1,023	1,058.0	1,095.0	1,139.0	1,182.5	1,245.0	1,315.0	1,316.0	1,342.0
[illegible]	972	1,035.0	1,044.0	958.0	1,095.0	1,138.0	1,150.0	1,172.5	1,193.0
[illegible]	911	926.0	931.0	960.0	995.0	1,028.0	1,049.0	1,057.5	1,065.0
[illegible]	911	945.0	972.5	980.0	[illegible]	1,010.0	1,041.0	1,070.0	1,069.5
71,	884	941.0	960.0	996.0	1,057.5	1,072.0	1,091.0	1,132.0	1,128.0
72,	788	815.0	840.0	869.0	891.0	919.0	950.0	980.0	990.0
Average,	948.0	982.0	997.0	1,023.0	1,069.0	1,111.0	1,129.0	1,151.5	1,162.0
Lot II.									
51,	882	912.5	951.5	980.0	1,025.0	1,059.5	1,083.5	1,160.0	1,127.0
52,	1,015	1,050.0	1,069 5	1,095.5	1,140.0	1,172.5	1,177.5	1,179.5	1,182.5
53,	963	1,007.5	1,019.5	1,055.5	1,087.5	1,116.5	1,140.0	1,172.5	1,184.5
54,	862	892.5	937.5	992.5	1,008.5	1,062.5	1,095.0	1,120.0	1,128.0
55,	976	1,007.5	940.5	1,062.0	1,102.5	1,175.0	1,187.5	1,217.5	1,238.0
56,	992	1,017.5	940.0	1,095.5	1,134.5	1,152.5	1,167.5	1,190.0	1,191.5
Average,	948.5	981.0	976.5	1,017.0	1,083.0	1,120.0	1,143.5	1.163.0	1,175.0
Lot III.									
57,	1,065.5	1,087.5	1,105.0	1,135.0	1,167.5	1,198.0	1,213.5	1,250.0	1,257.5
58,	1,064.5	1,117.5	1,150.0	1,155.0	1,180.0	1,213.0	1,218.5	1,237.5	1,244.0
59,	872.0	918.0	957.5	1,012.0	1,037.5	1,045.5	1,097.0	1,105.5	1,110.5
60,	888.5	917.5	965.5	975.0	1,010.0	1,037.5	1,067.5	1,092.5	1,096.5
61,	889.0	927.5	918.5	957.5	1,026.5	1,052.5	1,085.0	1,110.0	1,087.0
62,	923.5	947.5	975.0	962.5	1,030.0	1,053.5	1,078.5	1,085.0	1,087 5
Average,	950.5	986.0	1,012.0	1,033.0	1,075.0	1,100.0	1,126.5	1,146.5	1,147.0

The weights at the beginning and end of the experiment were obtained by weighing each individual animal on three consecutive days and taking the average of these weights. It is well known that a single weight may be quite misleading as regards the true weight of the animal. As shown in the table of weights, some individuals at some weighings apparently lost weight. This is undoubtedly due to the variation of the water in the system of the animal at the time of weighing and not to any unthrifty condition at that time, as some of these animals have made most excellent gains throughout the whole period of feeding, which would not have been expected had they actually lost in weight during two or four weeks of the feeding, as indicated by the table of weights. Animal No. 68 of Lot No. 1, at the third and fourth weighing, indicated a loss of 77 pounds for four weeks, while this animal gained throughout the whole period an average of 2.13 pounds per day. Without doubt, the weights were misleading and the animal did not show an unprofitable feeding condition. The following table gives the gain of each individual of each lot:

Steer No.	First weighing.	Last weighing.	Total gain, pounds.	Gain, per cent.	Gain per day, pounds.
63,	959	1,122.5	163.5	17.05	1.57
64,	1,013	1,242.5	229.5	22.66	2.21
65,	1,005	1,249	244	24.28	2.35
66,	1,015	1,216	201	19.91	1.93
67,	1,023	1,342	319	31.18	3.07
68,	972	1,193	221	22.74	2.13
69,	911	1,065	154	16.90	1.48
70,	911	1,069.5	158.5	17.40	1.52
71,	884	1,128	244	27.60	2.35
72,	788	990	202	25.63	1.94
Total,	9,481	11,617.5	2,136.5	....	20.54
Average,	....	....	....	....	2.05
51,	882	1,127	245	27.78	2.36
52,	1,015	1,182.5	167.5	16.50	1.62
53,	963	1,184.5	221.5	23.00	2.13
54,	862	1,128	266	30.86	2.56
55,	976	1,238	262	26.86	2.52
56,	992	1,191.5	199.5	20.12	1.92
Total,	5,690	7,051.5	1,361.5	....	13.09
Average,	....	....	....	....	2.18
57,	1,065.5	1,257.5	192	18.02	1.85
58,	1,064.5	1,244	179.5	16.81	1.72
59,	872	1,110.5	238.5	27.35	2.29
60,	888.5	1,096.5	208	23.41	2.00
61,	889	1,087	198	22.28	1.90
62,	923.5	1,087.5	164	17.76	1.57
Total,	5,703	6,883	1,180	....	11.34
Average,	....	....	....	....	1.89

From the above table it will readily be seen that Lot No. 2 made the greatest average gain per day; also, that Lot No. 1 occupies a medium position between Lots Nos. 2 and 3. There it not difference enough in the gains of the three lots to warrant the claim of marked superiority of one method over another, as the three lots gave about as uniform results as would be expected from three lots kept under uniform conditions. The objection to feeding a number of steers in a yard or pen has been raised, that there is likely to be both underlings and those that make unusually good gains. It is true that steer No. 67, of Lot No. 1, made considerably greater gain than any in Lots Nos. 2 or 3, and also that one steer, No. 69, made the least gain of any of the three lots, although No. 62, of Lot No. 3, which was confined in a stall, did not greatly exceed the small gain of steer No. 69. While the gains of the steers of Lot No. 1 occupy both extremes, yet they are sufficiently pronounced to warrant any definite conclusions being drawn from these results. The following table gives the amount of food consumed by each lot per pound of gain of live weight:

Food Consumed per Pound of Gain in Live Weight.

	Hay.	Stover.	Grain.
Lot I,	3.62	1.46	8.39
Lot II,	3.21	.94	7.82
Lot III,	3.47	.79	8.39

Amount of Food Consumed.

	Hay.		Stover.		Grain.	
	Total.	Per 1,000 pounds, live weight.	Total.	Per 1,000 pounds, live weight.	Total.	Per 1,000 pounds, live weight.
Lot I,	7,761.5	735.7	3,132.0	296	17,915	1,698
Lot II,	4,369.5	684.5	1,286.5	202	10,649.5	1,671
Lot III,	4,098.0	651.2	936.5	148.8	9,896.5	1,572

From the above it is seen that Lot. No. 2 made a pound of gain in live weight with the least amount of food. This lot also made the greatest total gain per day throughout the whole time of feeding. While Lot No. 1 made a somewhat greater gain than Lot No. 3, it evidently was at a somewhat greater expense of food, as Lot No.

3 required a trifle less food to produce a pound of gain than Lot No. 1. It is also shown that Lot No. 3 consumed less food per thousand pounds of live weight than either of the other two lots.

The differences in the results of these two methods of feeding, as shown by these trials, are not sufficient to warrant definite conclusions.

Experiment No. 3.

On April 1, 1901, six steers were placed on experiment similar to the one previously described. The main object of this experiment, however, was to determine whether there was a great difference in the retention and preservation of the manure made from the three lots. The steers were weighed at the beginning and end of the experiment, as described in experiment No. 1, and the food was weighed and fed as described in that experiment. Each lot consisted of two steers. The steers of Lot No. 1 were loose in a box stall and supplied with water by means of an automatic watering basin. The steers of Lot No. 2 were confined in stalls, but supplied with water by automatic watering basins, and Lot No. 3 was watered as were the animals of Lot No. 3 of experiment No. 2. The following table gives the weights of the steers at the beginning and end of the experiment, gain per cent. and gain per day in pounds:

	First weighing.	Last weighing.	Total gain, pounds.	Gain, per cent.	Gain per day, pounds.
Lot I.					
Steer No. 1,	912	1,081	169	18.53	2.96
Steer No. 2,	876	1,016	140	15.98	2.46
Average,	894	1,048.5	154.5	....	2.71
Lot II.					
Steer No. 3,	926	1,075	149	16.09	2.61
Steer No. 4,	862	1,046	184	21.35	3.23
Average,	894	1,060.5	166.5	....	2.92
Lot III.					
Steer No. 5,	976	1,131	155	15.88	3.04
Steer No. 6,	784	905	121	15.43	2.37
Average,	880	1,018	138	....	2.70

It will be observed that Lot No. 2 made a slightly greater gain than either of the other lots. Lots Nos. 1 and 3 were practically the same. The following table gives the food consumed for each lot. It should be noted that the coarse fodder fed these three lots consisted entirely of hay. While the gain of these steers in live weight corresponds quite closely to that of experiment No. 1, yet it is shown below that Lot No. 3 consumed considerably less food per pound of gain of live weight than either of the other two lots.

Food Consumed.

Date. For Week Ending:	Lot I. Hay.	Lot I. Grain.	Lot II. Hay.	Lot II. Grain.	Lot III. Hay.	Lot III. Grain.
April 9,	168	189	141	200	91	166
April 16,	164	228	144	206	87.5	148
April 23,	164	237	138	191	82	141
April 30,	167	200	164.5	218	128.5	169
May 7,	177.5	235	155.5	223.5	124.5	216
May 14,	176	234.5	160.5	224	129	234.5
May 21,	163	234	175	220	155	231
May 29,	192	268	173.5	264	†33	†60
Total,	1,371.5	1,825.5	1,252.0	1,746.5	840.5	1,365.5

† For two days only, Lot III was sold May 23.

Food Consumed per Pound of Gain in Live Weight.

	Hay.	Grain.
Lot I,	4.44	5.91
Lot II,	3.76	5.24
Lot III,	3.45	4.95

Labor Required.

The labor of attendance is often a deciding factor in the selection of stock for fattening, and it also determines the manner in which the stock should be fed. The cost of the manual labor required to take proper care of the stock in question sometimes determines the profit. Systems of feeding that require the least labor are to be preferred, provided, they are equal as to the amount of food required and the gain secured. The following table shows the amount of labor required for attendance for each lot during the entire feeding experiment of 104 days:

Time of One Man Required for Attendance.

	Number of animals.	Actual number of hours.	Hours.	Percentage of Lot 3.
Lot I,	10	79.6	79.6	51
Lot II,	6	88.8	*148.0	*95
Lot III,	6	93.3	*155.5	....

* Calculated to ten animals, the number in Lot I.

As shown above, it required 79.6 hours of actual labor of one man to attend to ten animals of Lot No. 1, and 93.3 hours of labor to care for six animals of Lot No. 3 that were kept in stalls and turned out to water once each day. If this proportion is used to determine the amount of labor required to care for ten animals in stalls, it will be seen, as shown in the above table, that steers in pens furnished with automatic watering basins required about one-half as much time of the attendant to properly care for them as was required to attend to the same number of animals kept in stalls and turned out in a yard to water. The stalls were cleaned out each day and the box stall was cleaned out twice during the experiment. The following table is taken from Bulletin No. 67, which gives the difference in time required to care for the three lots of animals which were kept under similar conditions as those described in the preceding pages:

Time of One Man Required for Attendance.

	Hours.	Percentage of Lot III.
Lot I,	93.66	76.0
Lot II,	113.33	92.0
Lot III,	123.25	....

In this experiment each lot consisted of five animals, which undoubtedly made the lots too small to note the greatest difference in the time of attendance.

Bedding Required.

It has been maintained that there is a saving in bedding when the animals are kept in large pens or yards. The question of saving bedding is oftentimes of considerable importance. In some localities, where large quantities of straw are available, it is desired to make use of the largest amount that can be used profitably. On the other hand, where there is a scarcity of bedding material, it is oftentimes desirable to care for the animals in such a manner that the least amount of bedding will be required. Throughout this feeding experiment a strict account was kept of the weight of the bedding material. Straw was used exclusively. This was weighed out in large sacks and a record kept of the number of sacks used for each pen. At the close of the experiment, it was found that the same number of pounds was used per animal in each lot. The use of straw was left to the judgment of the feeder. He determined how much was necessary to keep the animals clean and comfortable.

From the foregoing pages it will readily be seen that the differ-

ences in the results of the three methods of confining fattening steers, do not show that one method is markedly superior to another, so far as gain in live weight from the food consumed is concerned. The results of the three methods, as shown by each experiment, are about as uniform as would be expected had the three lots of them been kept under practically uniform conditions. The slight differences in gain are not sufficient to recommend one method over another. While the steers were selected with great care, yet the differences in the individuals of the three lots may account for the slight difference in gain. The fact that a different lot in each experiment made the greatest gain from a given amount of food, tends to show that the variation of the lots is probably due to the individuality of the animals rather than to the difference in the methods of confining and feeding.

It was observed in each experiment that those animals which had a supply of water before them all the time had a somewhat better appetite and consumed their food with greater relish than did those that were turned into the yard to water once each day. Any advantage that one method may show over another is chiefly due to the difference in the amount of labor of attendance.

ADDRESS DELIVERED BEFORE THE NATIONAL LIVE STOCK ASSOCIATION, CHICAGO, DEC. 8, 1901.

BY LEONARD PEARSON, *State Veterniarian of Penna.*

Mr. Chairman: I ask to be heard on this occasion as a delegate from an eastern State, the great dairy State of Pennsylvania.

The Grout bill, which proposes to put a tax on colored oleomargarine and to place the responsibility for the enforcement of this measure upon the federal authorities, is not a bill to interfere with the sale of uncolored oleomargarine, the poor man's substitute for butter, nor to tax oleomargarine out of existence. It is merely, as has been well said, to tax the fraud out of oleomargarine, for colored oleomargarine is a fraud, it is colored to imitate butter, so that it may be sold as butter to people who want butter, ask for butter and pay for butter. It is not colored for any other earthly reason. The purpose of the Grout bill is not to increase the cost of living, nor to prevent the cheapening of the diet of the workingman; it will not do this. It is to insure the sale of oleomargarine for what it is, and if it is sold for what it is, the workingman who wants it will get it cheaper than he will if it is colored and sold to him as butter. It is a bill to prevent counterfeiting, to prevent fraud; this and nothing more.

This Association has in the past put itself on record as opposed to the Grout bill. This action is construed in the east as in opposition to the dairy industry. I happen to belong to four representative associations of live stock men in Pennsylvania, none of which are members of this Association on account of the impression that this organization is the friend of bull butter as against cow butter. The Pennsylvania Breeder's Association, the Pennsylvania State Dairy Union and the Pennsylvania Jersey Cattle Club have not joined with you for this reason. The Pennsylvania Guernsey Breeder's Association was a member and withdrew after your hostile action on the Grout bill last year.

All that the dairy farmers of the east want is protection against unfair, dishonest competition. Many States have endeavored to protect themselves against this fraud by the enactment of State

laws, but in every State the enforcement of these laws is difficult by virtue of their lack of uniformity among the States on account of their failure to apply to original packages in interstate trade and on account of court delays. Only a federal statute can cover the ground fairly, and one is sorely needed.

Perhaps you do not realize the conditions that the eastern farmer is working under. There was a time not so long ago, when the beef, mutton and pork used in the cities of the east were produced on eastern farms. Farm land was worth from $75.00 to $200 per acre. Then came a time when the Government, with the cordial approval of these eastern farmers, gave to settlers in the west, virgin, fertile farms, or sold such farms for nominal prices. Great railroad systems built lines into these new regions and carried their products to the east at rates proportionately lower than were charged the eastern farmer. It became impossible for the eastern farmer to complete successfully in the meat and grain markets with the western farmer, encouraged in effect by governmental and corporate subsidy, and so the business of meat and grain production has been relinquished to the west. In the free use of public lands, the beef-cattle and the sheep industries are still receiving enormous governmental subsidies in comparison with which the subsidy asked for ocean steam ships is a mere bagatelle. This is the sort of competition that confronts the eastern farmer. Competition as strong as ever confronted and crushed out an industry, competition keener than had to be met by the rivals of the Standard Oil Company.

But agriculture in the east is not crushed; far from it, and largely because it is sustained by dairying. It is true that farm lands have lost more than fifty per cent. of their value and that good 100 acre and 200 acre farms may be bought for the cost of their fences and buildings, and that there is a constant migration from farms to towns; but there are still as many and as good farms and farmers in Pennsylvania as ever, and all are making a living and are educating their children. That the present measure of success if possible is due more to dairying than to any other thing.

Now what is it proposed that you shall do? That you shall advocate the defeat of the Grout bill and, practically, that you shall encourage the sale of colored oleomargarine as a fraudulent substitute for butter.

Colored oleomargarine is sold in dishonest competition with butter. It is cheap and can be sold as butter for a much lower price than butter. Suppose it causes a fall of but five cents per pound in the price of butter; this means a loss of $12.50 on the value of the product of a cow producing 250 pounds of butter a year. It means a loss of $125 on ten such cows, and a loss of $500 on forty cows of this class. You all know that this difference is oftentimes more than the difference between success and failure.

Why should you subject the eastern farmers and dairy farmers in general to this ruinous blow? Does the Grout bill threaten you? Will you get less for your cattle if there is a tax on colored oleomargarine? Of course not. The right to sell untaxed colored oleomargarine will help the packer and the oleomargarine manufacturers, but surely not the producer of beef. It seems to me that every principle of fairness, of honesty and of justice would impel you to protect dairymen from the dishonest competition that they now suffer from. It affects the cheese maker and milk shipper as much as it does the butter maker, because the price of butter governs the price of milk.

There is one other feature in this discussion that appears to be worthy of mention. The price of land in the east is now on a lower plane than it is in the Middle States and in the west. Farms that will raise a given amount of corn and pasture and a given number of cattle can now be purchased more cheaply in Maryland, New Jersey, Pennsylvania or New York than in Illinois or Iowa.

The price of beef is now at a point that is tempting to many dairymen; some dairymen in the Central States are now, notwithstanding the high price of butter, turning their attention to the production of beef. Free butter from unfair and dishonest competition and this change will not be extensive. Dairymen will stick to their trade. Permit the unrestricted sale of colored oleomargarine, the price of butter will fall, the dairymen will become beef producers and the price of beef will follow the price of butter.

Last week there was a fat stock show in Philadelphia, and on the night of Thanksgiving Day there was a banquet of five hundred men interested in the development of the home dressed beef trade as opposed to the trade in western dressed beef. It was shown that there is a large and growing demand for beef killed at home. You may be surprised to learn that the dealers in home dressed beef now have the upper hand in the markets of Baltimore, Philadelphia and New York. This means that there is to be more competition in buying butcher cattle, which will aid you, but it also means that when the eastern dairymen is compelled by dishonest competition to produce beef, he will not be without a local market.

The eastern farmers must change back to beef production, if they are driven to it by fraudulent competition in their special industry. There are 4,000,000 cattle in New York and Pennsylvania. If but ten per cent. of these are marketed as ripe beeves each year, it will mean the production of as many cattle as are now annually exported to England, and the effect of the sale of those 400,000 eastern steers will be felt keenly from Montana to Texas, and will lower the price of cattle in Omaha, Kansas City and Chicago; and what would the effect be if twice as many of them were so marketed each year?

And now, gentlemen, I ask you through a sense of fairness to your fellow farmers in the east and for the protection of your own business from serious competition in your best market, to earnestly advocate the Grout bill, and to tax the fraud out of oleomargarine. Can any reasonable man accept and use free or cheap government land, which is practically a subsidy, or ask for governmental aid for irrigation, or ask that wool be relieved from dishonest competition with shoddy, and at the same time refuse to grant dairymen the just protection they so sorely need?

RABIES.

BY MAZYCK P. RAVENEL, *Bacteriologist of the State Live Stock Sanitary Board, Philadelphia, Pa.*

SYNONYMS:

English, hydrophobia, madness; French, rage and hydrophobie; German, hundswuth, tollwuth, wuthkrankheit and wasserscheu; Italian, idrofobia and rabbia. Lyssa.

Rabies is an acute and very fatal disease, communicated from animal to animal, or from animals to man by the bite of an animal which already has the disease. As seen under natural conditions, it is always an inoculation disease, that is, communicated directly through a wound usually inflicted by the teeth, and the infective material being the saliva, which contains the poison or virus.

HISTORY. The history of rabies dates back into remote times, having been described distinctly by Aristotle, who lived in the year 326 B. C. He said: "Dogs suffer from madness, which puts them into a state of fury and all the animals that they bite when in this condition become also attacked by rabies." References to it are found in many of the authors prior to the Christian era, and from that date up to the present time, with the exception of the Middle Ages. In the first century of the Christian Era, we find the first description of rabies in the human being and the name "hydrophobia" given to it; this name being by common usage at the present time properly restricted to the disease as seen in man. The term means "fear of water," a symptom seen often in man, though not always, and which is not at all characteristic of the disease. It is not observed in the lower animals, and mad dogs will often lap water, and will even swim across streams.

As early as 1591, we find recorded the transmission of the disease by wolves to man. In 1803, and for a number of years following, it was epizootic among foxes in southern Germany and Switzerland.

During the later years of the eighteenth and the beginning of the nineteenth century the disease spread over the whole of Europe, and about this time made its appearance in America, the first outbreak in America being reported from Boston, 1768. In 1770-1771 it was observed in dogs and foxes in the vicinity of Boston; in the year 1779 it appeared in Philadelphia and in the State of Maryland, and in the year 1785 it was prevalent throughout the northern States, and soon after this time spread to the southern part of this country. During the last century it has inflicted severe losses throughout Europe, including England, and in America.

Its fatal character in animals, and especially in man, has attracted the careful study of many of the most able men who have ever adorned the ranks of the medical and veterinary professions. Among the famous men who gave great attention to it may be mentioned the great surgeon, John Hunter in England, Viborg in Copenhagen, Waldinger in Vienna, Hertwig in Germany and Pasteur in France. Without detracting in the least from the great work of other investigators, we may say that to Pasteur and his co laborers, Nocard and Roux, we owe most of the knowledge which we have of the disease at the present day.

Distribution. At the present time rabies is known in almost every country on the globe, Australia being the only one which is absolutely exempt, owing to the rigid quarantine enforced against the importation of dogs. It is most common in France, Belgium and Russia. In the latter country it is perhaps more often seen in wolves than any other part of the world. In Holland, Denmark and Sweden it is very rare. In England it has from time to time been wide spread, but at the present time, owing to strict measures, it has been practically stamped out.

The careful inquiries of Dr. Salmon, Chief of the Bureau of Animal Industry, show that rabies is seen in practically every part of the United States. The census for 1890 reported 143 deaths in man, distributed in thirty States. The figures for the census of 1900 are not available, but Dr. Salmon has collected from health officers the reports of 230 deaths occurring in seventy-three cities since 1890.

There is no systematic report of rabies in the lower animals in Pennsylvania, or any other State, so that it is impossible to give any idea of the number of dogs or other animals affected yearly. There is no doubt, however, that the disease is more prevalent than is generally believed, and there is good reason to fear that it will increase until uniform and efficient laws are adopted for its suppression. The laboratory of the State Live Stock Sanitary Board has investigated 82 cases of rabies, as proven by inoculation and microscopic examination, since October, 1897. Of these 58 were dogs, 4 horses, 17 cows, 1 cat and 2 human beings. All of these except six dogs and one person were from the State of Pennsylvania. A number of other cases have been seen in dogs at the Hospital of the Veterinary Department of the University of Pennsylvania during the past three years.

It is impossible to say what relation these recorded cases bear to the total number which have occurred throughout the State during the same period of time, but they indicate that the disease is more common than is generally suspected.

Animals Affected. All mammifers, including man, are liable to rabies. Birds also may contract the disease. The dog is the

animal most constantly affected, but it is seen not infrequently in wolves, foxes, hyenas and jackalls. Rabies in the cat is relatively rare and usually caused by the bite from a dog with which it is associated. Cattle, sheep and goats are affected in relatively about the same degree, cattle and sheep being especially exposed. It is more rarely seen in the horse. Swine contract the disease less frequently than other domestic animals.

The money losses from this source reach a very high figure. In the State of Pennsylvania the loss of stock each year is not inconsiderable, although not reaching a very high figure. During the past year in one herd of sixty cows, eleven died of rabies, worth about $600.00. Several outbreaks have occurred also among sheep, in one flock twenty out of fifty having died.

In England the losses among deer in several parks have been very heavy. In 1889 rabies appeared among the fallow deer at Richmond, and soon after in the park of the Marquis of Bristol. In the course of three months more than 450 died out of the herd, which contained between 600 and 700 animals.

The disease is rarely transmitted from one of the domestic animals to another. Bites from these animals are less dangerous than from dogs on account of the blunt character of their teeth, which inflict contused wounds rather than punctured ones. The disease may, however, be transmitted in this way, and also by the deposit of virulent saliva on wounds of the skin by licking. Deer are said to be able to transmit the disease to others by biting.

Cause of the Disease. Nature of the Virus. Although we have every reason to believe that rabies is due to a specific germ, all attempts to isolate it have so far failed. We, however, understand much of the nature of the virus, the condition which affect it, etc.

In rabid animals it is found principally in the saliva and in the central nervous system, although it is known to pass sometimes into other glands as the lachrymal and pancreas and also into the milk. It has never been found in the blood or in any of the organs such as the liver, spleen and kidneys, nor is it ever contained in the muscular tissues. The contents of the stomach may contain it, owing to the swallowing of the saliva previous to the paralysis of the throat. It affects principally the central nervous system, and it is found most certainly, and in the most concentrated condition in the medulla oblongata. The virus may be present in the saliva for at least three days before the animal shows any symptoms of madness, as proven by Roux and Nocard, and, perhaps, as long as eight days. It may be present in the central nervous system

for two days before the appearance of symptoms. The symptoms do not show themselves until the poison or virus has remained in the nervous tissues long enough to bring about changes in their structure and functions.

METHOD OF INVASION. When introduced into another animal either experimentally or in the natural course of the disease, the virus remains for a time without producing either local or general symptoms, undergoing a period of incubation during which it undoubtedly multiplies itself, in this respect corresponding to the well known infectious diseases. It may be removed from the saliva by filtration through porcelain, proving that it is a solid body. The virus penetrates to the nervous system by following the nerve trunks from the site of injury to the spinal cord, then the spinal cord to the medulla and brain. This has been proven by inoculating an animal in one of its legs with virulent material. After a suitable time, but before the symptoms of rabies appear, if the animal be killed, the virus will be found in the nerves of the limb, and even in the part of the spinal cord into which the nerves enter, while the upper part of the cord and brain will be free from it. This fact explains the reason why the earliest symptoms, both in man and animals, such as pain, itching, tingling, numbness and other nervous sensations, often appear in the part of the body which received the virus through the bite. In the case of a bite about the face and head, the route along the nerves to the central nervous system is shorter still. While the nerves then form the main route by which the virus travels, the circulation may at times assist, especially in small animals. Inoculation into the large nerve of the leg is almost as certain to produce the disease, as inoculation directly into the sub-dural space, while injection beneath the skin of the leg is not so sure.

RESISTANCE OF VIRUS. The action of the virus is destroyed by drying, and by the action of light. In dry air protected from the light and from putrefaction, the virulence of the spinal cord of rabbits is destroyed in fourteen to fifteen days. When spread in thin layers the virus is destroyed entirely by drying in four to five days. Sunlight destroys it in about forty hours. The loss of virulence by drying is gradual and quite regular, and this is taken advantage of in the preparation of the "vaccine," which is described later. The virus may be preserved unchanged in neutral glycerine at ordinary temperature for a long time. Roux found that after four weeks in glycerine at 30 degrees C., the virus has the same power as when perfectly fresh.

It is quite resistant to putrefaction. Galtier has found the virus active in the central nervous system of rabbits buried for twenty-

three days, of sheep buried thirty-one days, and of dogs buried forty-four days. Other observers have found it still active in animals buried for twenty-four days.

It is destroyed completely by a temperature of 50 degrees C. (122 degrees F.) in one hour, or 60 degrees C. (140 degrees F.) in one-half hour. It is uninjured by exposure to extreme cold, resisting the prolonged application of a temperature from 10 degrees to 20 degrees below zero, centigrade.

Its activity is destroyed in one hour by a 5 per cent. solution of carbolic acid, or by a 1 to 1,000 solution of corrosive sublimate. Water saturated with iodine destroys it in ten minutes.

Danger from Bites. The danger of infection as well as the time elapsing between the introduction of the poison and the development of the disease is dependent upon a number of factors. The disease appears more quickly in children than in older persons, and for obvious reasons they are more often attacked by dogs, and the bites are more apt to be on the face and head. Wounds about the head and face are particularly dangerous, next comes bites about the hands, and lastly, other parts of the body. The richer the nerve supply of a part the greater the danger. Punctured wounds are most dangerous, and lacerated wounds are dangerous in proportion to the extent of the surface afforded for the absorption of the virus. The danger of infection varies with the animal which inflicts the bite. First, comes the wolf; second, the cat; third, the dog, and, fourth, other animals. In the western part of the United States the skunk is said to be very liable to the disease, and the bite from this animal is quite dangerous. Bites on naked or exposed parts of a person are more dangerous than through clothing, in the latter case the virus being wiped off and not gaining access in quantity to the tissues. The same thing is observed among the lower animals, as dogs with long hair, like the spaniel and the collie, are less liable to the disease than are short-haired dogs. Experimentally, it has been shown that rabbits which are shaven and exposed to the bite of a mad dog are more often affected than are those bitten through the fur, even when the teeth penetrate deeply beneath the skin. The proportion of persons who contract hydrophobia after being bitten by mad dogs, and are not treated, is conservatively estimated at 16 per cent., but some series of cases give a much higher mortality. Thus, of 855 cases collected by Tardieu, Thamhayn and Bouley, 399 ended in death, or 46.6 per cent. In another series of cases given by Bouley, out of 266 persons bitten, 152 died of hydrophobia; but of these, 120 were bitten on the face and hands, the greater danger from which has been mentioned.

The mortality following bites from wolves is placed at from 60 to 80 per cent., the increased danger from these animals being due

partly to the greater activity of the virus as found in them, and partly to their mode of attack, wounds about the face and heads being common, and the wounds being very extensive.

Of animals bitten by rabid dogs, it is claimed that only from 20 to 30 per cent. become infected. Röll calculated that during the years 1877-1887 the percentage in horses was about 40, among cattle and sheep, 50, among pigs, 36, and among goats, 20. It will be seen from these figures how unnecessary it is to destroy all animals bitten by dogs believed to be or even known to be made.

Period of Incubation. By the period of incubation is meant the time which passes between the introduction of the virus or germ of a disease, and the appearance of the symptoms. This is quite variable in rabies, depending on the site of the wound, which is almost always a bite, the amount of virus introduced, and the strength of the virus. In general it may be said for all animals that the period of incubation seldom exceeds sixty days, though in man and in some of the larger animals, it sometimes, though very rarely, reaches one year. The average period is as follows:

In man, 40 days.
In dogs, 21 to 40 days.
In horses, 28 to 56 days.
In cows, 28 to 56 days.
In cats, 14 to 28 days.
In pigs, 14 to 21 days.
In goats and sheep, 21 to 28 days.
In birds, 14 to 40 days.

Influence of Seasons. It has been for a long time believed, and apparently with a certain degree of truth, that rabies in dogs is more frequent during the hot months than at other periods of the year, and as a result of this we would expect to find more persons bitten during the periods of extreme heat than during the rest of the year. The old statistics in France, dating from the year 1850 to 1876, indicate that 30.4 per cent. of all cases of rabies occurred during the months of June, July and August. The figures collected at the Pasteur Institute in Paris do not, however, agree with these, the maximum number of bitten persons applying for treatment there during the years 1886 to 1893 being in March, April and May, and the minimum number in September, October and November. The statistics collected by Bouley give for December, January and February, 755 cases; March, April and May, 857 cases; June, July and August, 788 cases, and September, October and November, 696 cases, showing a fairly uniform distribution for the whole year. The maximum number, occurring during March, April and May, agrees with the figures of the Pasteur Institute.

I quote a table compiled by Dr. Salmon, Chief of the Bureau of Animal Industry, giving the occurrence of 14,066 cases by months:

CASES OF RABIES IN DOGS, BY MONTHS.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Bourrel,	36	31	26	32	32	42	32	30	35	41	24	32	393
Saint Cyr,	12	15	6	15	13	7	4	9	1	3	......	2	87
Hegyes,	309	310	314	367	450	502	580	537	455	438	303	396	4,961
Leblanc,	103	97	121	192	155	138	147	123	104	117	95	100	1,492
France:													
1895,	89	155	153	184	181	129	157	147	133	110	105	149	1,692
1896,	124	138	151	150	147	199	158	117	131	125	103	164	1,687
1897,	131	151	189	202	225	172	192	154	136	131	150	149	1,973
1898,	139	148	......	181	216	278	165	177	170	......	153	154	1,781
Total,	943	1,045	960	1,323	1,419	1,467	1,435	1,294	1,145	965	933	1,137	14,066

The highest number of cases occurred in June, and the smallest number in November. Taking the total result as given by this table, in connection with the other figures quoted, it may be said that more cases of rabies occur from April to September, inclusive, than during the rest of the year. In giving a proper value to these figures it must be noted that during the warm months of the year, dogs are more apt to be running abroad, while during the winter months they are more apt to be housed. In this way opportunities for contagion are greater from April to September than from October to March, and there is no evidence that of itself that season has anything to do with the greater or less frequency of rabies.

ERRONEOUS IDEAS CONCERNING RABIES. There is a rather wide-spread belief that if a dog which has bitten a person ever goes mad the bitten person is also liable to go mad, and this superstition leads to the useless destruction of a considerable number of dogs. It probably has its origin in the fact that the virus is present in the saliva for several days before symptoms of madness are shown by the dog, and that certain persons have contracted hydrophobia following the bite of such an animal, which, at the time, showed no symptoms of madness. It can be stated with the most absolute certainty that the bite of a healthy dog, or a dog suffering from fits, or when angered or excited, can produce no ill effects in the bitten person other than that dependent on the extent of the injury. Such wounds should be treated by modern antiseptic methods, cauterization being unnecessary.

The Mad Stone. Persons bitten by dogs strongly suspected of rabies should at once take the advice of a competent physician, and if the diagnosis is confirmed, go as rapidly as possible to some institution where the Pasteur treatment can be applied. No dependence whatever can be placed upon the so-called "mad-stones."

Pseudo-Hydrophobia, or Lyssophobia. It is to be regretted that the opinion is so wide-spread, even among some physicians, that fright following the bite of a dog can bring about symptoms of hydrophobia, followed by death. It cannot be denied that such symptoms do sometimes occur in persons bitten by dogs known to be free from hydrophobia, but the writer has failed to find reliable report of any death in such cases. Recovery usually takes place in a few days under very simple treatment, though the symptoms sometimes persist for a considerable time, ending, however, in complete recovery.

Can Rabies or Hydrophobia Arise Spontaneously? It is supposed by some persons that rabies can be produced by fright, fatigue, anger, jealousy, high feeding, excessive heat and other influences—an error which was pointed out by Virchow in Germany many years ago.

After what has been said of the nature of the virus it is manifest that this is impossible. Each case of rabies is due to contagion from some other case just as truly as each case of measles or scarlet fever in children is due to the germ from some other case gaining entrance to the system. Rabies cannot arise of itself from any cause.

Dog Days. The belief that dogs are particularly apt to go mad during the so-called dog-days is shown by the law, still enforced in some places, requiring the muzzling of dogs during this period. As has been shown in another part of this article, rabies occurs during every month of the year.

The term "dogs days" refers to the "dog star," Sirius, and was originally applied to the period of time during which the dog star was above the horizon with the sun. At present they are usually reckoned from July 3 to August 11, inclusive. Dogs are not more liable to go mad during this period than at other times.

Rabies in Man. The course of the disease in man may be divided into three stages, a premonitory stage, a stage of excitement and a paralytic stage.

In the first stage there is usually irritation about the point of inoculation, or else pain, numbness or a tingling sensation; depression and melancholy are observed, the disposition becomes irritable, and there is a sense of great fatigue with restlessness and often a feeling of impending danger; the sensibilities are increased, noise or light causing distress. The first difficulty in swallowing may appear. During this stage the voice becomes husky. The pulse and temperature are increased.

In the second stage the chief symptoms are great excitability and restlessness, and hyperaesthesia is marked: "Any efferent stimulant—i. e., a sound or a draught of air, or the mere association of a verbal suggestion—will cause a violent reflex spasm. In man this

symptom constitutes the most distressing feature of the malady. The spasms, which affect particularly the muscles of the larynx and mouth, are exceedingly painful and are accompanied by an intense sense of dyspnoea, even when the glottis is widely opened or tracheotomy has been performed." (Horsley.) These spasms are brought on by any attempt to drink water, or by touching with a wet towel, and so painful is the result that patients come to dread the sight of water or even liquids of any sort. It is from this symptom that the name of hydrophobia (dread of water) is derived. There may be maniacal symptoms with the spasms, and occasionally furious mania is seen. This is exceptional, however. During the spasms difficulty of breathing occurs, and curious sounds may be uttered from which the exaggerated reports of people barking like dogs arise. This stage lasts from a day and a half to three days and is succeeded by the final or paralytic stage, which ends in death in from six to eighteen hours, the heart's action becoming more and more feeble and death occurring from syncope.

Rupture of the muscles during the convulsions may take place and give rise to distressing symptoms. Emphysema, or a filling up of the loose tissues under the skin with air coming from the lungs through tears in the pleurae also occurs at times.

Rabies of the Dog. The disease is seen in two types, a furious, and tranquil or paralytic type.

Furious Type. In the furious type the first symptoms consists solely in changes in the disposition of the animal, which are manifested by distress or uneasiness, and restlessness. He is always easily excited. At this stage, the animal does not usually show a disposition to bite; he is still docile and obeys orders, though not so quickly as in health; he soon seeks solitude and shows a disposition to hide in dark corners, or burrow in the straw of his kennel; periods of calmness alternating with marked excitement are observed; he still shows affection for his master and may respond to caresses even more affectionately than is his wont. He may, however, be irritated by strangers, or being surprised by touch or blow, may inflict a bite. The appetite is still good and may be even excessive. Soon the restlessness becomes more marked; the dog is constantly in motion; he is apt to tear carpets, rugs, etc., which may be in the room with him; he shows signs of delirium, looking off into space, apparently seeing some imaginary object; at times he will attack an imaginary enemy. He will still respond to his master's voice, but his attention cannot be held for any length of time. At this early stage, the voice becomes modified, and this may be regarded as one of the most typical symptoms. Instead of the clear and sharp bark which is natural, the latter part of the note becomes prolonged and of a higher pitch, going off into a plain-

tive cry, which has been likened to that of a dog fatigued in the chase, and in succeeding short barks which may follow, the jaws do not close completely as in ordinary barking.

While this symptom is a striking one and quite constant, it may be lacking at times and certain dogs remain quiet in spite of all attempts to excite barking. The appetite diminishes about this time; food is taken with more or less difficulty, and soon it is refused, swallowing having become painful and difficult. The animal may appear to have a bone stuck in its throat, a symptom which often tempts the owner to make the dangerous examination for some obstruction. There is no fear of water, and the animal drinks water and other liquids quite greedily, until paralysis of the constrictor muscles of the pharynx makes swallowing impossible.

The excitation becomes marked and the animal is now furious. If a stick or other article is presented to him he seizes it with power; he attacks the bars of his cage or any object in the cage. If at liberty, he attacks every object in his way, swallowing all sorts of articles, such as wood, paper, straw and stones, the presence of which in the stomach after death is one of the most striking features of the disease. At this time he begins to wander, running with his tail hung, the mouth open and the eyes with a wild look; he attacks every object or animal which comes in his path. As a rule, he runs straight ahead and does not turn out of his way to attack animals. The dog may travel tremendous distances, but is apt to return to his home, exhausted and covered with dust and blood, or else he may continue his course until he falls exhausted, as much as fifty miles being covered. Very soon paralysis sets in, commencing in the hind legs, and finally becomes general. The dog is no longer able to stand; the weakness becomes more marked and stupor sets in, from which the animal may be aroused, but which becomes deeper and deeper, and ends in death. The course of the disease is always rapid, covering from six to ten days, and averaging from four to five days. The symptoms are so characteristic that once seen can scarcely be mistaken for any other disease. The furious type just described is the most common.

Paralytic Form. The paralytic type, ordinarily spoken of as "dumb rabies," constitutes from 15 to 20 per cent. of all cases. In certain countries, as in Turkey, it is the prevailing type, which explains the relative rarity of rabies in man in this country where dogs abound. The commencement of the disease is the same as in the furious type, but the accesses of fury are lacking. For several days the dog appears restless, seeking seclusion and dark places. The paralysis may commence in various parts of the body, but, as a rule, affects first the muscles of the jaw, which soon drop, the dog being unable to close its mouth, and the tongue hanging out;

the whole expression of the animal is pitiful in the extreme; an abundance of saliva runs from the mouth; the taking of water is impossible; the mouth becomes dry and covered with dust, and brownish. The animal is quiet; it does not respond to provocation, nor does he seem to wish to bite. The progress of the disease is more rapid than in the furious type. The paralysis extends and death occurs on the second or third day.

Other cases are observed in which the type of the disease is more or less intermediate between the two just described. There are some in which a very short period of fury is followed by a rapid paralysis, while in others the paralysis is more slow in its progress and the animal shows a slight disposition to attack when irritated. In the "dumb" type of the disease it is common to suspect an obstruction in the throat, and in the attempt to locate it the saliva may infect wounds of the hand. The animal never wanders and, being unable to bite, the danger of transmission of the disease is slight.

Rabies of the Cat. This animal shows first a period of restlessness, with a disposition to hide in dark corners. It soon becomes furious and leaves its place of retreat and is liable to attack any one who comes within its reach. The bites inflicted by it are, as a rule, very serious. It shows the same perversion of appetite as seen in the dog. After five or six days paralysis of the hind legs begins; swallowing becomes impossible and death soon follows. The paralytic form, or "dumb" rabies also occurs, causing death in from three to four days.

Rabies of the Horse. In the horse, excitement is an early symptom, with a marked sensitiveness of the skin, and hallucinations. If it can reach the point of inoculation, it bites itself constantly, tearing the skin and often the deep tissues. The appetite ceases, or becomes capricious and irregular. Like the dog he eats earth, wood or anything within his reach. In the attempt to swallow water it may be thrown out through the nostrils. A slight annoyance renders the animal furious and he attacks with ferocity any animal or person. The attacks of fury become more and more frequent. The pulse may reach 100 to the minute, and respiration is difficult. Paralysis commences in the limbs and soon becomes general. Death occurs from asphyxiation in from three to six days.

Rabies of the Cow. The symptoms in these animals are much the same as those just described. There is often an intense irritation at the site of the wound. Changes in the appetite occur and rumination stops. In about twenty-four hours after the appearance of the first symptoms, fury becomes manifest; there is bellowing, and hallucinations, which are evident from the aspect of the countenance as well as the actions. Swallowing becomes difficult, saliva

flows in abundance from the mouth. Waving the hand or a stick at the animal is sufficient to make it attack. In the intervals of fury the animal is somnolent, dull. Death usually occurs by paralysis, starting often in the limb which was bitten. The animal soon becomes prostrated and dies on the fifth or sixth day. In these animals, as in others, the paralytic or "dumb" form is seen also.

The symptoms as seen in goats, deer and sheep do not differ materially from those already described.

A symptom more or less common to all animals is the irritation about the site of the inoculation wound, this being often the earliest symptom which attracts attention.

Rabies of Birds. The disease in birds is apt to be of the paralytic type, and its duration is more chronic than in any animal, lasting from fourteen days to several weeks, and occasionally ending in recovery. The crow, falcon and old pigeons are refractory to the disease, while chickens, geese, owls and young pigeons contract it readily. The period of incubation in geese and owls is about fourteen days, while for the chicken it may reach forty days. The degree of virulence of the virus with which the inoculation is made seems to have but little effect on the rapidity of incubation. The blood serum and brain matter of birds which resist the disease destroy the virus. The changes in the central nervous system are the same as those which have been found in man and in the domestic animals, and are especially marked when the disease is slow in its progress.

Appearances After Death. There is no change in animals which have died of rabies which can be considered specific of the disease. The cadaver is apt to be emaciated and becomes putrid rapidly. The blood is dark and thick; the brain and its membranes may be congested, even show slight hemorrhages, and the respiratory and digestive tracts show a catarrhal condition, with slight hemorrhages. Perhaps the most constant feature is the presence of foreign bodies such as wood, straw, hair, etc., in the stomach and the absence of food, this condition having been found in 90 per cent. of 200 cases in dogs examined by Axe.

The absence of changes, which may be considered as belonging specifically to rabies, is no doubt due many of the erroneous ideas which have been held concerning the disease.

Until recently, the only way of making a certain diagnosis after death, was by the inoculation of other animals with a portion of the brain or spinal cord of the dog. For this purpose the rabbit has been usually selected, as being one of the most susceptible of all animals to the disease. Injections into the muscular tissues of any part of the animal with the virus of rabies, will almost certainly produce the disease, but it is more quickly produced by inocu-

lation beneath the membranes of the brain. For this purpose a small button of bone is taken from the skull, just large enough to admit the insertion of a hypodermic needle, and three or four drops of a suspension of the brain, made by rubbing with water in a mortar, is introduced. The wound in the skin is washed with carbolic acid and then sealed with collodion and cotton. The rabbit shows no inconvenience from the operation whatever, and will eat and play within a minute after its completion. If the operation is done in a cleanly manner, and the material is fresh and has not undergone decomposition at all, no ill effects are observed until symptoms of hydrophobia present themselves. This seldom occurs in less than three weeks, and may not take place until sixty days have passed. The symptoms as seen in the rabbit are well defined and entirely diagnostic. The form of the disease in rabbits after such inoculation is almost always the paralytic, though at times the animals become furious, biting a stick or any other object within their reach. Before the death of the animal its symptoms are carefully noted, and after its death the brain and organs are examined, and cultures made from the blood and all organs, with the object of making sure that the animal died of hydrophobia, and not of some accidental infection, in which case the germ producing that infection would be manifest in the cultures. When the inoculated animal dies before the fourteenth or fifteenth day we may be reasonably sure that it has not died of rabies, but as a result of the operation. This examination can be carried out properly only by those who have had special training, and should not be attempted by others.

Microscopic Examination. In a disease marked by such striking symptoms referable to the nervous system, it is natural to expect that changes would be found in the central nervous system sufficient to account for the production of symptoms. As well stated by Babés, "this disease so clearly characterized by a train of symptoms, constant in their character, ought also to present characteristic lesions in the nervous centers, and especially in the ganglia which preside over the production of symptoms." Numerous studies have been undertaken by workers in various parts of the world, with the object of discovering some change in the nervous system which could be considered as belonging especially to rabies, but while changes were found, none of them could be considered as specific.

Recent Advances in our Knowledge. During the year 1900, the discovery of changes distinctive of rabies was announced by Van Gehucten and Nélis. These changes are found in the peripheral ganglia of the cerebro-spinal and sympathetic systems, and are especially marked in the plexiform ganglion of the pneumogastric nerve and the gasserian ganglion. Normally, these ganglia, are

composed of a supporting tissue holding in its meshes the nerve cells, each one of which is enclosed in a capsule, made up of a single layer of endothelial cells. (Fig. 1.) The action of the rabic virus

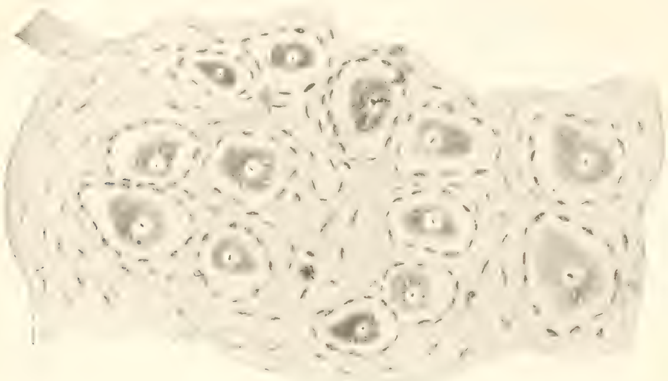


Fig. 1. Normal Ganglion. (Reproduced after Crocq, Journal de Neurologie, Vol. V., No. 13).

seems to exercise its effect on these cells particularly, bringing about an abundant multiplication of the cells forming this capsule, leading finally to the complete destruction of the normal ganglion

Fig. 2. Plexiform Ganglion of Rabbit, dead of rabies produced by sub-dural inoculation. The capsules are filled, or partially filled by the new formed cells.

cell and leaving in its place a collection of round cells. (Fig. 2.) Ordinarily a considerable number of ganglion cells will be found which have undergone only a slight change, but under certain condi-

tions the process is so widespread that all the ganglion cells are destroyed. The intensity of these changes varies in different animals; they are perhaps most pronounced in the dog, less marked in man and still less in the rabbit.

Much of the value of these findings consists in their affording a quick and sure means of making a diagnosis. It is possible to complete the examination within six hours after the death of the animal, and under ordinary circumstances a positive opinion can be given in from twenty-four to thirty-six hours. It is important that the animal should be allowed to die, and not be killed prema-

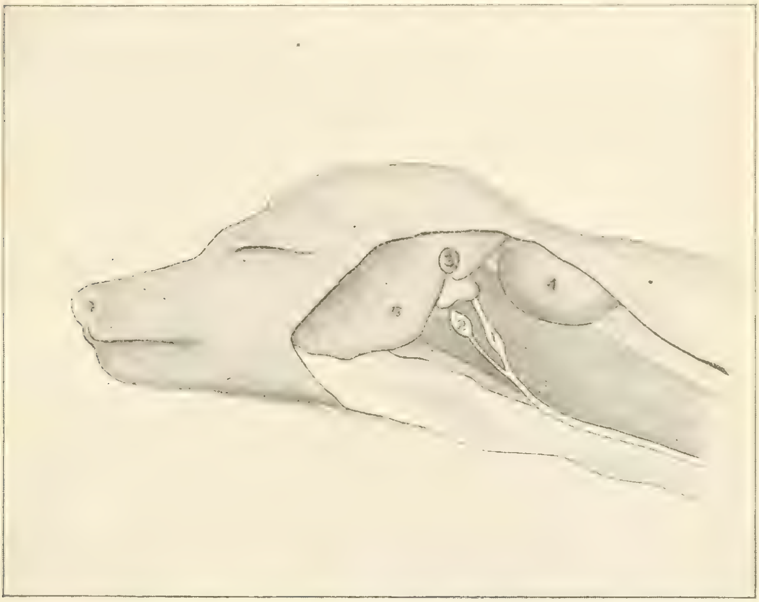


Fig. 3. Dissection of the upper neck of dog, showing the Plexiform Ganglion of the Pneumogastric nerve, in which the changes are usually sought for 1. Plexiform Ganglion. 2. Cervical Ganglion. 3. External auditory meatus. 4. Atlas. 5. Inferior Maxilla. (After Valee-Diagrammatic).

turely, as where the disease is not permitted to run its full course ending in death, the changes may be absent or only slightly developed.

The ganglion on the pneumogastric nerve is selected by preference and should be removed as soon as possible after the death of the animal. (Fig. 3.) It is put into absolute alcohol, or in 10 per cent. formalin solution. If put into absolute alcohol it should be removed to a fresh portion of alcohol at the end of six hours, in which it remains for six hours, when it may be transferred for one hour to a mixture of absolute alcohol and chloroform, and then put for one hour in pure chloroform, then one hour in a mixture

of chloroform and paraffin, and lastly imbedded in pure paraffin. If formalin is used for fixing, the ganglion should be removed at the end of six or eight hours, put for six hours more in 95 per cent. alcohol, and then into absolute alcohol for six hours, after which it may be fixed to blocks for cutting, by mucilage of gum arabic, or else imbedded in collodion. The characteristic changes in the capsule are brought out best by the use of hematoxylin, or hemalum, and eosin. The method of Nissl gives good results also, but as it requires some special technical knowledge to be efficiently carried out, the former is recommended for its simplicity and ease of execution. This method has stood the test in Europe and America for nearly two years, and although a large number of animals having different diseases have been examined with the object of determining whether or not these changes may occur in other conditions, they have never been found.

At the laboratory of the State Live Stock Sanitary Board, which was the first in this country to take up this method, fifty-two cases have been examined since May, 1900, without a single failure. These cases have occurred in mankind, dogs, cows, cats and rabbits, and the characteristic changes have been found in each of these species. We have not had an opportunity of examining horses, sheep or swine. In this laboratory it has replaced the slower and less certain method of inoculation almost entirely. Inoculations are now practised only in those cases in which the material is sent in such condition that the microscopic examinations is impossible.

Treatment. When once the symptoms of rabies have manifested themselves, treatment is of little avail, either in man or in animals. Except for the purpose of making a sure diagnosis, animals may be destroyed at once. In man, the only treatment possible is directed to the control of symptoms, such as the spasms, and the relief of suffering. All that can be done is to give anti-spasmodics, such as chloral, bromides and morphine in large doses, or else resort to the inhalation of chloroform. It is better not to waste time by giving the milder anti-spasmodics, but to begin at once with the strong ones like morphine and chloroform, which should always be administered under the direction of a physician.

In birds and animals a few cases of recovery have been observed even after inoculation with the virus in good quantity. In man the disease is uniformly fatal, consequently our measures to be successful must be directed to preventing the development of the disease after inoculation by the bite of a rabid animal.

Pasteur Method. Treatment must, therefore, be preventive and not curative. The only method which is worth while mentioning is that of Pasteur, by which an immunity is produced by the subcutaneous injection of the virus of rabies in an attenuated form,

beginning with the mildest virus and going gradually up to one which possesses full virulence. This attenuation of the virus is brought about by drying at a fixed temperature, and the action of the atmosphere. Depending upon the length of time the virus is exposed to these influences, we can obtain any degree of virulence desired, the loss of virulence under fixed conditions being quite uniform.

The disease as seen in dogs infected naturally was called by Pasteur "street rabies," and the virus from such animals is known as the "virus of street rabies." Such virus will produce the disease in rabbits by intra-cranial inoculation in from three to four weeks as a rule. By inoculating rabbits in series, one from the other, we obtain a reduction in the period of incubation so that after about 100 passages, rabbits will die on the sixth or seventh day after inoculation with great certainty. Beyond this point no increase of virulence can be obtained, therefore, to this virus the name of "fixed" was given. It is with this "fixed" virus that all of our methods of vaccination are carried out.

Preparation of Vaccine. The spinal cord of a rabbit which has died after inoculation with this "fixed" virus is removed with the greatest precaution to prevent contamination. It is then cut into three portions, of equal length, and suspended by a silk thread in a large bottle containing a layer of caustic potash at the bottom. The bottle has an opening near the bottom as well as at the top, both of which are plugged with cotton, to allow a free passage of atmospheric air. These are kept in a dark room at a carefully maintained temperature of 23 degrees C. Under these conditions the cords lose their virulence entirely in about fifteen days. Those kept for fourteen days have a very slight degree of virulence, and furnish our weakest virus with which the vaccination is begun. On succeeding days cords which have been dried for thirteen, twelve, eleven, etc., days, are used, until one which has unimpaired virulence may be injected with perfect safety. The method was tried at first on animals with perfect success, and since 1885 has been applied to persons bitten by rabid animals. The treatment is varied slightly according to the extent of the bites and their location. The simplest form requires fifteen days, the next eighteen days, while what is called the "intensive" treatment, employed where the bites are about the face, and in portions of the body rich in nerve supply, requires twenty-one days. The one most commonly used is given below:

TREATMENT MOST COMMONLY USED—18 DAYS.

Day of Treatment.	Age of the Cord.	Quantity Injected.
1,	14 days,	3 cubic centimetres.
	13 days,	3 cubic centimetres.
2,	12 days,	3 cubic centimetres.
	11 days,	3 cubic centimetres.
3,	10 days,	3 cubic centimetres.
	9 days,	3 cubic centimetres.
4,	8 days,	3 cubic centimetres.
	7 days,	3 cubic centimetres.
5,	6 days,	2 cubic centimetres.
	6 days,	2 cubic centimetres.
6,	5 days,	2 cubic centimetres.
7,	5 days,	2 cubic centimetres.
8,	4 days,	2 cubic centimetres.
9,	3 days,	1 cubic centimetre.
10,	5 days,	2 cubic centimetres.
11,	5 days,	2 cubic centimetres.
12,	4 days,	2 cubic centimetres.
13,	4 days,	2 cubic centimetres.
14,	3 days,	2 cubic centimetres.
15,	3 days,	2 cubic centimetres.
16,	5 days,	2 cubic centimetres.
17,	4 days,	2 cubic centimetres.
18,	3 days,	2 cubic centimetres.

RESULTS OF TREATMENT. Since the commencement of the Pasteur Preventive Treatment, some 55,000 persons have been inoculated, the treatment now being administered in twenty-five laboratories in different parts of the world. The total average mortality at all these laboratories is about 0.77 of 1 per cent. This includes a number of people who have been bitten by wolves, the bites of these animals being especially fatal, the mortality reaching as high as 80 per cent. in every 100 bitten. At the parent institute in Paris from 1886 to 1899, inclusive, 23,245 cases have been treated, of whom 103, or 0.44 of 1 per cent. have died. The mortality during the first year was 0.94 of 1 per cent., and has steadily gone down until during 1899 it was 0.25 of 1 per cent., the lessened mortality being due to some extent at least to the smaller number of persons bitten by wolves who have been treated there in late years, owing to the fact that there have been laboratories instituted in other pars of Europe nearer to the regions where wolves abound.

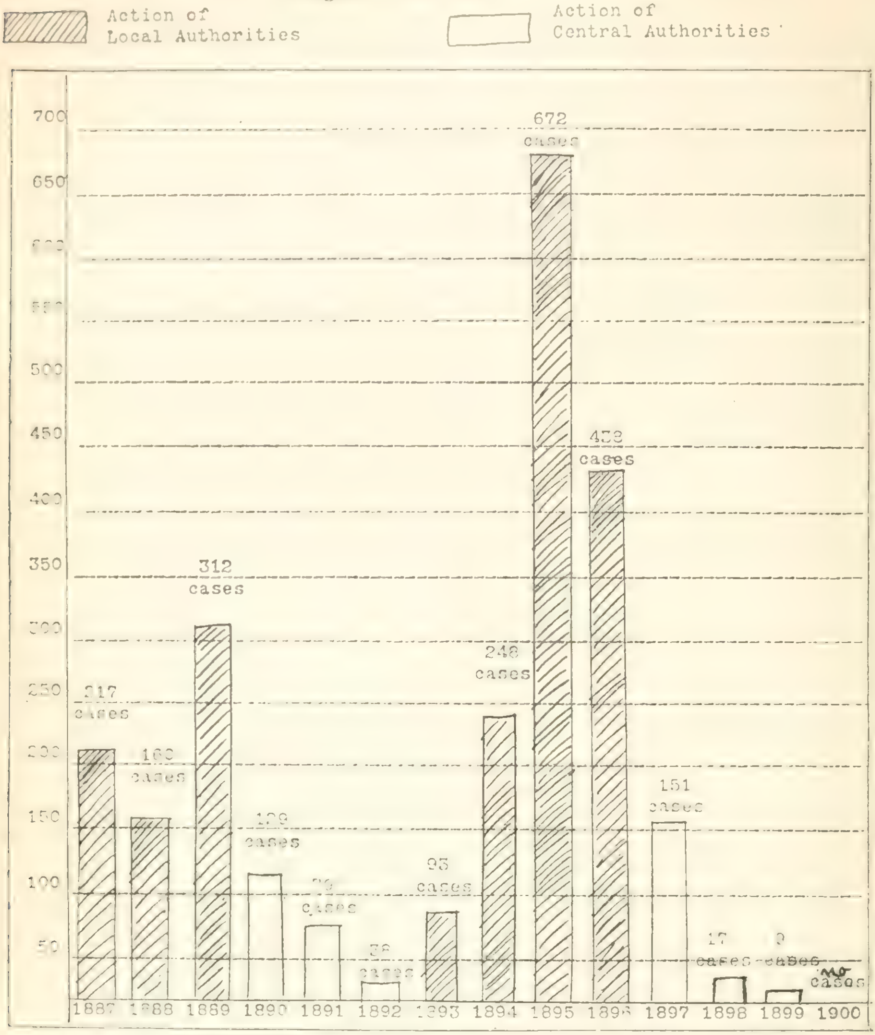
The value of the preventive treatment is well brought out by statistics. In Hungary, from April 15, 1890, to December 31, 1890, 5,899 persons were bitten, of whom 4,914 were inoculated, with a mortality of 1.2 per cent., while the mortality among those who did not take the treatment reached 14.94 per cent. The treatment is absolutely free from danger, and has no ill effects whatever except soreness at the point where the injections are made. Persons undergoing it are not confined to the house, but are able to go backward and forward from their homes to the institution.

APPLICATION TO ANIMALS. A large number of experiments have proved that the Pasteur treatment is applicable to animals also,

though the shorter period of incubation which is the rule in many of them, makes it less sure, and the expense attending it has prevented its general use. At the Veterinary Department of the University of Pennsylvania it has been successfully applied in several instances, the "vaccine" having been furnished by the New York City Department of Health.

PREVENTION AND ERADICATION OF THE DISEASE. As regards both man and animals the only rational procedure is to attempt the eradication of the disease, and since it is kept alive by the canine race our measures must be directed to the control of dogs. Among the respective measures which have been advocated may be mentioned a high tax, muzzling and the leash. During outbreaks which excite terror in a community we see not unfrequently the enactment of the most extreme measures, such as the destruction of all dogs, which is totally unnecessary. The results obtained by strict enforcement of muzzlings seem to justify its recommendation. To this measure is ascribed the eradication of the disease from Berlin in the year 1854-1855, and the recent results obtained in Great Britain are most striking. The official reports of Great Britain show that in 1887 there were 217 cases of rabies; 1888, 160; 1889, 312. Owing to the alarm caused by this increase, muzzling was adopted, with the result that in 1890, 129 cases were seen; in 1891, 79 cases, and 1892, 38 cases. There was much opposition to the enforcement of the muzzling ordinance and it was relaxed, with the result that in 1893 the number of cases rose to 93; in 1894, to 248 cases, and in 1895, 672 cases were seen. Owing to the alarm muzzling was again enforced, resulting in a great reduction in the number of cases, to 438 in 1896, 151 in 1897, 17 in 1898, and 9 in 1899. From November, 1899, to January 1, 1901, not a single case of rabies has been reported in England or Scotland, according to official statistics just issued for the year 1900.

Table Showing Effect of Enforcement of Muzzling by Central Authorities in England 1887–1900.



Professor MacFadyean says in his report: It appears probable that the past year (1900) will remain memorable as the one in which rabies was eradicated from Great Britain. As a matter of fact, no case of the disease was detected in England or Scotland during the past twelve months, and the only cases reported during the year were in Wales. The total number of dogs attacked was six, but five other animals were destroyed in consequence of having been bitten by rabid dogs. No case of the disease has been detected in dogs since the second week of October last."

Precautions to be Taken by Person Bitten. In the event of a bite by an animal supposed to be mad the wound should be cau-

terized as soon as possible with fuming nitric acid. This should be thoroughly applied to all parts of the wound, making sure that there are no pockets or recesses which escape the action of the acid. If such cauterization is carried out within twenty-four hours of the reception of the wound, the danger is very much lessened, and if done within a few hours the protection is absolute. In the absence of fuming nitric acid the hot iron or the thermo-cautery, or even strong antiseptics may be used, but experiments have shown that nitric acid is the most efficient. The invariable rule should be: *Cauterize as soon as possible, and in the meantime do everything to get the virus out of the wound*, by washing in an abundance of water, enlarging the wound and encouraging free bleeding by cupping or the application of ligatures around the limb above the site of injury. Osler advises that the wound be kept open for five to six weeks.

The animal which inflicted the wound *should in no case be killed but should be captured, if possible, and confined for observation.* In this way it is often possible to determine positively within a day or two whether the animal was really rabid, and much anxiety spared the bitten person. As soon as the animal dies the whole head should be cut off close to the shoulders, packed in ice and sent to the nearest laboratory for examination. In the State of Pennsylvania, the Laboratory of the State Live Stock Sanitary Board undertakes this work free of expense, and in the majority of cases a positive opinion can be given in twenty-four hours after the receipt of the head. Where the animal has been killed, either by intention or accident, a positive opinion cannot be given in many cases in less than from three to six weeks, as the result of inoculation must be waited for. The same is true where only a portion of the brain is sent, since the changes which indicate rabies that can be detected by the microscope are found only in the medulla oblongata, and in the ganglia found on some of the nerves. From these facts, the great importance of sending the whole head and neck will be seen.

Disposal of Bodies of Animals which Have Died of Rabies. The flesh of animals which have died of rabies, or have been killed on account of it, is unfit for food. If possible, the carcass should be destroyed by burning, or be sent to a knacker's, where it is cooked in the process of utilizing it commercially. If this is not possible, it should be deeply buried under a layer of quick lime. The law of France allows the removal of the skin, and its sale after disinfection, which is done by immersing it in a 2 per cent. solution of sulphate of zinc, or in corrosive sublimate, two parts to 1,000.

Disinfection. All bedding used by an animal with rabies, and all remains of food, etc., should be destroyed by burning. Collars, chains, halters, blankets, feed-pans and other such articles should

be well washed with a 5 per cent. solution of carbolic acid, and exposed to the sun for two or three days after. Every part of the kennel, room or stall should be washed with the same, and after drying receive a thick coat of whitewash. In the case of horses, cows and such animals, particular attention must be paid to the feed and water troughs, as the chief source of contagion is the saliva, and these articles are especially apt to be contaminated. In all cases it is best to leave the kennel or stall vacant for two weeks, and in the meantime expose them to the sun and air as freely as possible.

FREE RURAL MAIL DELIVERY.

AN ADDRESS PREPARED FOR THE INTERNATIONAL GOOD ROADS CONGRESS, HELD AT BUFFALO, N. Y., SEPTEMBER 16-21, 1901.

BY HON. A. W. MACHEN, *General Superintendent Free-Delivery System, Post-Office Department.*

"No other branch of our great postal system is as far-reaching in its effects as the rural free-delivery service. It means the extension of the post-office to the doors of the people. The rural letter carrier is in fact a traveling post-office, performing practically all the functions of a postmaster. Besides delivering and collecting ordinary mail, he delivers registered letters, registers letters, sells stamps and stamped envelopes, cancels the stamps on the letters he collects, and receives money en route for the purchase of money orders. He is an anticipated and welcomed visitor to the country home and becomes a fixture in farm life.

It is no wonder, then, that the people want a service of this kind, and that the demand for it has gradually become more and more urgent, until to-day it is practically universal and not to be resisted. The people are determined to have it, and after receiving it are bound that is shall be efficient and satisfactory. This it can not be unless the roads over which it is operated are in good condition. Good roads are indispensable to a really efficient rural service. It is essential that the service be performed with regularity and punctuality. It must be a daily service, and the patron must be reasonably sure that the carrier will pass the gate at about the same time every day. A well-built and well-kept road will permit of such a service; over bad roads it can not be maintained. Even though a carrier is able to cover his route over bad roads, the time consumed is often from one to three hours in excess of what it should be were the highways in proper condition. A good rural service, then, means good roads, and, as the people insist upon the former, they must eventually obtain the latter.

It should, therefore, be apparent to anyone who gives the subject careful consideration that the good roads propaganda, which started some years ago with the progressive business people of our country, must receive a powerful impetus from the establishment of this new and popular service.

It may be said that the only obstacle now encountered in the extension of rural free delivery is the unimproved condition of our country roads. In many sections of this country the roads are what are called dirt or mud roads. They are narrow and tortuous, and the only work done on them is practically confined to going over them with a road machine or scraper once a year. The principal effect of this work is to pile up in the middle of the road all the muck and rubbish which has accumulated on the sides during the rest of the year, so that in wet weather, unless the soil is very sandy, the whole surface becomes rutted and is soon converted into a series of mud holes. This is particularly the case in most of the farming sections of the Middle West and to a large extent in the South; also as far east as western New York and Pennsylvania.

The Department soon became convinced that steps should be taken to remedy these conditions if a desirable rural service was to be provided. When it was demonstrated that the rural free-delivery service would become a permanent feature of the postal service of the United States, the Post-Office Department promptly laid down as one of the requirements for the establishment of rural free delivery that the petitioners for the same must agree to place the roads to be traversed by the proposed service in a passable condition and keep them in repair throughout the year. Petitions including the agreement that the Department's requirement in this particular will be met are promptly referred to special agents for investigation. A special agent drives over the highways of a proposed route, and is required by the regulations to make a special report on their condition. In many instances special agents find themselves obliged to exact a pledge from road supervisors or other officials having charge of the building and maintenance of public highways that the roads will be improved before the service is established, and kept in proper condition after the same has been put in operation. In Iowa alone over 100 agreements have been entered into between county commissioners and special agents of the rural free-delivery service to open, repair and maintain roads.

This plan is producing very good results. Reports come from all sections of the country to the effect that, prompted by a strong desire to obtain rural free delivery, the people are not only insisting on the improvement of roads in advance of the service, but that creeks have been bridged, in many instances, by substantial stone bridges, for the especial accommodation of the rural letter carriers.

Now that I have shown what the Department is doing to bring about an improvement of the public highways in advance of the establishment of rural free delivery, I will briefly explain the efforts it is putting forth to effect a betterment of the roads where the service has been in operation for some time, and where failure in the past

to maintain daily trips on account of the poor or impassable condition of the roads during certain seasons of the year has brought forcibly to the attention of the Department the absolute necessity of repairing these roads to insure a continuance of the rural free delivery service. After routes have been established and in operation for some time, route inspectors are sent out at regular intervals to make a general investigation of the rural system. Among other points on which they report are the quality and condition of the highways traversed. These inspectors are required to specify definitely such portions of the highways traveled by rural carriers as are impassable, and to give the names and addresses of the road supervisors or others in authority who are responsible for their repair and maintenance. In addition to this information the Department has gathered data from more than 2,400 of the rural free delivery post-offices bearing upon the condition of the public roads. The information has been received in answer to the following questions:

What is the condition of the roads traveled by the rural carrier?

Were the roads impassable at any time during the past winter; if so, how many days and for what cause?

Are the roads being properly repaired this year?

If any roads need attention, give name and address of road supervisor or other official.

The replies received show that the roads from 666 post-offices were in bad condition; at 1,814 they were fair, passable, and good. The names and addresses of 1,101 road supervisors were also furnished, and their attention has since been called to the condition of the highways under their supervision, with an urgent request that repairs be made before winter weather again sets in. The letter written to road supervisors reads as follows:

"Dear Sir: An investigation by this office discloses the fact that the roads traveled by the rural carrier from ——— ——— post-office are not being attended to as post-roads should be; they are in bad condition. The postmaster at ——— has this day been notified to inform the patrons of route —— that the lack of care given to the roads covered by it will, if continued, endanger the permanency of the service there. A rural carrier can not possibly make regular time or perform efficient service over bad roads, particularly during winter and spring.

Now is the time to mend these highways, and it is the hope of the Department that the roads over which you may have direct supervision will be repaired before winter weather sets in, so that the continuance of the rural free delivery service may be insured.

For Government publications and full information on road building apply to Director, Office of Public Road Inquiries, Department of Agriculture, Washington, D. C.

Respectfully,

——— ———,

General Superintendent."

Every one of the postmasters of the 666 post-offices referred to received the following instructions bearing upon the question of roads:

"Dear Sir: Reports recently received from your office show that the roads traveled by rural carrier ——— are in bad condition.

You will please notify the patrons of route —— that the present lack of attention to these roads will, if continued, be likely to endanger the permanency of the rural free delivery service there.

A rural carrier can not possibly make regular time or perform efficient service over poor roads, particularly during the winter and spring months. The summer is the time for mending these highways, which are really serving as post-roads, and which should always be passable for the transport of the mail. It is the hope of the Department that the patrons who are receiving the benefit of the service appreciate it, and that they will promptly co-operate in an effort to repair all deficient portions before winter sets in, so that the permanency of rural free delivery service may be insured.

For Government publications and full information on road building apply to Director, Office of Public Road Inquiries, Department of Agriculture, Washington, D. C.

Respectfully,

——— ———,

General Superintendent."

In a large number of localities this letter has had the effect of directly enlisting in the cause of better roads those who are particularly interested in an efficient rural free delivery, namely, the patrons of the service, and they have not been slow to second the efforts of the Department to arouse the road supervisors to a full appreciation of the necessity of promptly complying with the Department's request for an improvement of the highways. While replies to the foregoing letters were not requested, a large number of them have been received from postmasters and road supervisors, indicating that the communications have had the desired effect. The following letters may be quoted as samples:

"Newark, Ill., October 1, 1901.

General Superintendent Free Delivery System, Washington, D. C.:

Sir: I am pleased to inform you on rural delivery routes Nos. 1 and 3 there has been and is now being done more work on the roads than

any one year for some years past. This is undoubtedly due to the notice sent to the road commissioners by your Department. The commissioner of each route inquired of the carried where he considered the worst roads on his route, and then proceeded to repair these portions expressly. The carriers are highly pleased.

——— ———, Postmaster."

"Mediapolis, Iowa, September 24.

General Superintendent, Washington, D. C.:

Dear Sir: The roads have been recently repaired and are now in good condition.

Very respectfully,

J. K. Mathews, Postmaster."

"Bonner Springs, Kans., October 25, 1901.

General Superintendent Free Delivery:

Dear Sir: Referring to yours of October 22, would like to say that the work which was delayed on route on account of inability to secure enough teams and men to do the work is being pushed now with all possible speed; good arched culverts are being put in and the surface leveled down and the roads put in good shape. They have never been in so good shape before.

The postmaster, Mr. Maxwell, told me to say that he had been over the road, and that it was in better shape than he had expected to find it. The work will be done as fast as possible.

Yours truly,

W. G. Maupin, Trustee."

"Kansas, Ill., September 26, 1901.

General Superintendent Free Delivery System:

Dear Sir: The road commissioners have agreed to put in the bridge and fix the roads. Thanks.

Yours truly,

W. S. Grinnell, Postmaster."

Such letters are being constantly received from all sections of the country, more especially from the New England and the West and Middle States.

It is the intention of the Department to continue on these lines, and by every possible means to point out to the people that a prompt and regular service can be provided only where good roads are maintained. Postmasters will be requested to report from time to time on the condition of the roads, and in that way the Department will be kept continually and intelligently in touch with existing conditions. The need for this work may be more clearly shown and the effect of

it on the highways of the entire country may be better understood and appreciated by considering a few figures relative to the rural free service as it exists to-day.

The total number of carriers employed in the rural free delivery service at present is about 5,700; total population served by them daily, about 3,500,000; total number of miles traveled each day, about 140,000.

When one considers that no two carriers (with few exceptions) travel over the same roads, it becomes clear that if the Department succeeds in its efforts for good roads on the routes now traveled by the 5,700 carriers, there will be 140,000 miles of good roads in the country districts now enjoying the benefits of rural delivery. At the present rate of increase the rural service will be practically doubled within the next twelve months, and as it is the distinct policy of the Department to extend the service and keep pace with the demand for it (which is constantly increasing), we may look forward to the time when all sections of the country in which this service may be feasibly maintained will be covered by a network of rural routes.

Wherever there is a systematic extension of the service throughout a whole county it is found that fully nine-tenths of the public highways are covered by rural free delivery. If, therefore, reliable statistics were at hand showing the total number of miles of public roads in rural districts of the United States, an interesting estimate might be made showing the total number of miles of public highways of the United States that will eventually be covered by rural free delivery service and consequently become good roads. All, I think, will agree that the rural free delivery is proving a potent factor in the construction of good highways and their proper maintenance. It is obvious, too, that the people, by insisting upon a universal extension of the service, have in their hands the most effective means possible for bringing about the general improvement of nine-tenths of the public highways of this country. This has been the object for which good roads commissions and other kindred organizations have been working for years, and a propaganda is still being vigorously carried forward not only by these organizations, but by the Government itself, through the efficient management of the Office of Public Roads Inquiries of the Department of Agriculture.

While it is true that the good roads movement has received a great impetus and made rapid strides during the past few years on account of the very efficient support is has received from the Department of Agriculture through the publication of literature on road building, securing the construction of object-lesson roads, etc., I think all will concede that the Post-Office Department is not overstepping the bounds of modesty when it claims that the solution of the whole question lies largely in the rapid and systematic extension of the rural free-delivery service."

DECISIONS OF THE DEPARTMENT OF AGRICULTURE.

PART I.

RULINGS ON "THE PURE FOOD LAW" OF JUNE 26, 1895.

1.—All foods manufactured, sold, offered or exposed for sale are held to be represented as pure, unless accompanied by adequate notice to the contrary, in which case they must be distinctly labeled as "mixtures" or "compounds," or as "artificial" preparations.

2.—Food sold as pure must be true to name, of standard strength, quality and purity, and not a compound, mixture or an artificial preparation or imitation.

3.—Where no standard of strength, quality or purity is fixed by law, the standard required shall be that adopted by the highest recognized authorities, such as the United States Pharmacopoeia, or the Association of Official Agricultural Chemists.

4.—No food shall have added to it any substance or ingredient "which is poisonous or injurious to health."

5.—No fraudulent or worthless article having little or no food value, shall be mixed with standard goods or substituted for them, and be sold as food under the label "compound" or "mixture;" but all foods sold under this designation must be composed of substances recognized as "ordinary articles or ingredients of articles of food."

6.—The question of the admissibility of a non-poisonous or harmless foreign substance in a food, may depend upon whether the substance introduced is necessary in order to improve the value or quality of the food, or is fraudulently added as a diluent and cheapener.

7. No food shall be sold under the name of a substance of which it contains none or only an inconsiderable quantity, and when a name is "coined" therefor such name shall not be suggestive of any substance not contained therein.

8.—Foods manufactured in Pennsylvania, except where exempt by statute from such requirement, should, for the purpose of identification, be labeled with the name and address of the person or firm manufacturing them. Foods not so marked are regarded with suspicion.

9.—Artificial preparations or imitations shall not be labeled "extracts," as "artificial vanilla extract," etc.

10.—Where such words as "compound," "mixture," "artificially colored," etc., are required upon a label, they shall be in conspicuous places and be printed in bold, clean-faced type in letters as large and conspicuous as any upon the package, and the same designation, both as to substance, size and conspicuousness, shall be printed upon the carton.

11.—The use, in food, of a moderate quantity of coloring matter that is not poisonous or injurious to health, is not prohibited, provided the goods are otherwise pure and of standard quality; except in the case of oleomargarine, milk, cream and distilled vinegar, in which the use of certain colors is prohibited by statute; but if used in foods below the established standard of strength and quality, the words "artificially colored" and "compound" or "mixture" must be printed upon the label.

12.—Articles of food that can be prepared by the use of improved processes, so as to preserve them from decay or change, shall have no preservative added, other than salt, syrup, sugar, saltpetre, spice, vinegar or wood smoke.

13.—When an "extract" is below standard, and yet contains a sufficient quantity of the substance after which it is named to entitle it to be labeled as a "compound" or "mixture," the percentage of its distinguishing ingredient or ingredients should be stated on its label.

14.—Dry mustard must be pure. A preparation of mustard, vinegar and spices may be sold if labeled "prepared mustard." Mustard may also be sold when mixed with vinegar, spices and sufficient starch to secure a mild flavor, if labeled "prepared mustard, compound."

15.—Mixtures of a spice with one or more of its valuable by-products, as pepper with pepper hulls, or pure cloves with cloves from which part of the essential oil has been removed, must be labeled "compound" or "mixture." Spice by-products, themselves possessed of spice value, must be sold under their own, distinctive names. Spice preparations with which any foreign material has been mixed shall not be sold as "compounds" or "mixtures."

16.—Coffee mixed with chicory, wheat, rye, peas, etc., cannot be sold as "coffee compound."—Decision of Attorney General, January 29, 1896. Packages containing such articles may be sold if they have the name of the adulterant plainly printed on the label.

17.—Candy and confections must be free from inert mineral matter, and not colored with substances poisonous or injurious to health.

18.—The distinctive character of a Baking Powder should be stated on the label, as Cream of Tartar, Alum, Acid Phosphate, etc.

19.—Tin on cans in which food is preserved, and the portion of the metal tops of glass jars which is in contact with food contents, should not contain more than two per centum of lead.

NOTE.—Under the statute a dealer is liable for selling an adulterated article, although he may have no knowledge that the same is adulterated.

A guaranty of purity received from the manufacturer or jobber does not relieve a person handling adulterated goods from liability.

PART II.

ABSTRACT OF STATUTORY REQUIREMENTS RELATING TO CHEESE; DAIRY PRODUCTS IN CHARITABLE OR PENAL INSTITUTIONS; EVAPORATED APPLES AND APPLE PRODUCTS; FRUIT JUICE; LARD; MILK AND CREAM; OLEOMARGARINE; PURE FOOD; RENOVATED BUTTER; VINEGAR.

CHEESE.

Act of 23d of June, A. D. 1897.
Amended 2d of May, A. D. 1901.

1.—Must be the legitimate product of pure, unadulterated milk or cream.—Sec. 1. Act 1897.

2.—No foreign fats or substance can be introduced.—Sec. 1; Act '97.

3.—Must be branded: Full Cream; Three-fourths Cream; One-half Cream; One-fourth Cream; Skimmed Cheese, together with the manufacturer's name and address.—Sec. 2; Act 1897.

Where cheese is manufactured outside of the State, a brand, giving the grade, together with the name and address of the dealer is sufficient.—Decision of Attorney General Oct. 27, 1897.

4. Percentage of butter fat required.—Sec. 2; Act 1897:

Full cream, 32 per cent.
Three-fourths cream, 24 per cent.
One-half cream, 16 per cent.
One-fourth cream, 8 per cent.
Skimmed cheese, less than 8 per cent.

5.—Full cream cheese shipped out of the State need not be branded.—Amendment May 2, 1901.

6.—"Fancy" cheese, under five pounds in weight, and cottage and pot cheese, are not included in the provisions of this law.—Sec. 3, Act '97.

7. NOTE.—Manufacturers or dealers in cheese violating any of the requirements of the Pure Food Law of June 26, 1895, can also be arrested and punished under its provisions.

DAIRY PRODUCTS IN CHARITABLE AND PENAL INSTITUTIONS.

Act May 23, A. D. 1893.

1.—It is unlawful for any charitable or penal institution to use or furnish to its inmates any article, designed to take the place of butter or cheese derived wholly from pure unadulterated milk or cream.—Sec. 1.

Persons selling substitutes for butter or cheese, not made from pure unadulterated milk or cream, are also liable to prosecution for every such offense.—Sec. 2.

EVAPORATED APPLES AND APPLE PRODUCTS.

Act of July 5, A. D. 1895.

1.—The adulteration of "apple vinegar," "jellies," cider," evaporated apples" and "other apple products," is prohibited.—Sec. 1.

2. NOTE.—Persons violating the requirements of this law can also be prosecuted under the provisions of the Pure Food Law of June 26, 1895.

FRUIT JUICE.

Act May 2, A. D. 1901.

1.—No "deleterious" or "poisonous acid" or other "unwholesome, deleterious or poisonous substance" can be sold or given away as a substitute for the pure, unadulterated and unfermented juice of lemons, limes, oranges, currants, grapes, apples, peaches, plums, pears, berries, quinces, or other natural fruits, under the representation that such preparation is the pure, unadulterated and unfermented juice of any such fruits.—Sec. 1.

2.—No one shall knowingly use any such compound in the mixing, decoction of, or preparation of, food or drink, or any such compound or preparation in the place of, or as a substitute for, the pure unadulterated and unfermented juice of one or more such fruits.—Sec. 1.

LARD.

Act June 8, A. D. 1891.

1.—Lard sold as such must be the pure fat of swine.

2.—Lard not wholly derived from the fat of swine, must be sold

in packages or wrappers on which is plainly marked on the outside in letters not less than one-half inch in length, the words "Compound Lard."

3. NOTE.—Action can also be brought against persons who sell impure or adulterated lard, under the Pure Food Act of June 26, 1895.

MILK AND CREAM.

Act of 19th April, A. D. 1901.

1.—The addition of coloring matter or preservatives, to milk or cream, is prohibited.—Sec. 1.

2. NOTE.—Action can also be brought against persons who sell impure or adulterated milk, under the Pure Food Law of June 26, 1895.

OLEOMARGARINE.

Act of 29th May, A. D. 1901.

1.—Oleomargarine is any substance "made wholly or partly out of any fats, oils or oleaginous substance or compound thereof not produced from pure unadulterated milk or cream from the same, without the admixture or addition of any fat foreign to the said milk or cream."—Sec. 1.

2.—Oleomargarine "shall be made and kept free from all coloration or ingredients causing it to look like yellow butter."—Sec. 1.

3.—All persons "desiring to manufacture, sell or offer or expose for sale, or have in possession with intent to sell, oleomargarine not made or colored in imitation of yellow butter, must first procure a license so to do, from the Dairy and Food Commissioner."—Sec. 2.

4.—All licenses expire December 31st of each year. Licenses may be granted for a portion of a year upon payment of a proportionate part of the annual fee.—Sec. 2.

5.—License fee for twelve months for a

Manufacturer,	$1,000
Wholesale dealer,	500
Retail dealer,	100
Restaurant, dining room or hotel proprietor,	50
Boarding house keeper,	10

—Sec. 2.

6.—Wholesale dealers, are all persons who shall buy to sell again and make sales in quantities of ten pounds and over.—Sec. 2.

7.—Retail dealers, are all persons who sell in quantities of less than ten pounds.—Sec. 2.

8.—License is granted for a specified location only, but may be transferred to another individual proposing to engage in business in the same place, on application to the Dairy and Food Commissioner.—Sec. 2.

9.—The license must be exhibited in a conspicuous place, on the walls of the room or store in which the business is conducted.—Sec. 3.

10.—Every person, firm or corporation, before beginning business under this law, shall procure from the Dairy and Food Commissioner a sign or signs clearly setting forth that he, she or they, are engaged in the manufacture or sale of oleomargarine; which said sign or signs shall be hung up in a conspicuous place or places on the walls of every room or store in which oleomargarine is manufactured or sold.—Sec. 3.

11.—Every proprietor of a hotel, restaurant, dining room or boarding house, shall, in addition, have conspicuously placed upon every counter or table at which food, meals, or refreshments are served to customers, a placard, plainly printed in letters not less than one-half inch in length, stating that oleomargarine is used and served to customers.—Sec. 3.

12.—Every tub, package or parcel containing oleomargarine shall be distinguished on the outside, in a conspicuous place, by a placard with the word "OLEOMARGARINE" printed thereon; the letters to be not less than one inch long, and the placard shall not contain any other words thereon.—Sec. 4.

13.—Upon every open tub, package or parcel containing oleomargarine, there shall be displayed, in a conspicuous position, a placard with the word "OLEOMARGARINE" printed thereon in letters not less than one inch long; and when oleomargarine is sold from such tub or package or otherwise at retail, in print, roll or other form, before being delivered to the purchaser, it shall be wrapped in wrappers plainly stamped on the outside thereof with the word "OLEOMARGARINE" printed or stamped thereon in letters one-fourth inch square. The wrapper shall also contain the name and address of the seller and the quantity sold, and no other words thereon, and the said word "OLEOMARGARINE," so stamped or printed on said wrapper, shall not be in any manner concealed.—Sec. 4.

14.—Manufacturers and wholesale dealers in oleomargarine shall keep a book in which every sale and shipment of oleomargarine shall be entered, giving the date of sale and shipment, the quantity, the person to whom sold and shipped, the place to which shipped and the name of the transportation line by which shipped, which book

shall be in such form as the Dairy and Food Commissioner shall direct and shall be open to examination by the Dairy and Food Commissioner, his agents, attorneys and representatives.—Sec. 5.

15.—Retail dealers in oleomargarine shall also keep a book, which shall be open to examination by the Dairy and Food Commissioner, his agents, attorneys and representatives, in which shall be entered the date of the receipt of all purchases of oleomargarine by him, stating therein where, when and from whom purchased, and the quantity; said book to be in such form as the Dairy and Food Commissioner shall direct.—Sec. 5.

PURE FOOD LAW.

Act of June 26, A. D. 1895.

1.—The manufacture, sale, offering for sale or selling adulterated food is prohibited.—Sec. 1.

2.—The term "food" as used in this act "shall include all articles used for food or drink by man, whether simple, mixed or compound." —Sec. 2.

3.—An article shall be deemed to be adulterated within the meaning of this act,

(a) IN THE CASE OF FOOD:

(1) If any substance or substances have been mixed with it, so as to lower or depreciate or injuriously affect its quality, strength or purity.

(2) If any inferior or cheaper substance or substances have been substituted, wholly or in part, for it.

(3) If any valuable or necessary constituent or ingredient has been, wholly or in part, abstracted from it.

(4) If it is an imitation of, or is sold under the name of, another article.

(5) If it consists, wholly or in part, of a diseased, decomposed, putrid, infected, tainted or rotten animal or vegetable substance or article, whether manufactured or not—or in case of milk, if it is the product of a diseased animal.

(6) If it is colored, coated, polished or powdered, whereby damage or inferiority is concealed, or if by any means it is made to appear better or of greater value than it really is.

(7) If it contains any added substance or ingredient which is poisonous or injurious to health: Provided, That the provisions of this act shall not apply to mixtures or compounds

recognized as ordinary articles, or ingredients of articles of food, if each and every package sold or offered for sale be distinctly labeled as mixtures or compounds, and are not injurious to health.—Sec. 3.

RENOVATED BUTTER.

Act 10th of July, A. D. 1901.

1. "Taking original packing stock and other butter and melting the same so that the butter oil can be drawn off, mixed with milk or skimmed milk or other material, and by emulsion, or other process, produce butter, and butter produced by any similar process and commonly known as boiled or process butter," shall be known and designated as "Renovated Butter."—Sec. 1.

2.—Persons desiring to engage in the business of manufacturing or selling renovated butter are required to take out a license, to be issued by the Dairy and Food Commissioner.—Sec. 2.

3.—All licenses expire December 31st of each year. Licenses may be issued for a portion of a year upon payment of a proportionate part of the license fee.—Sec. 2.

4.—The license fee for twelve months is for a

Manufacturer,	$1,000
Wholesale dealer,	500
Retail dealer,	100
Restaurant, dining room or hotel proprietor,	50
Boarding house keeper,	10

—Sec. 2.

5. Wholesale dealers are all persons who sell in packages of ten (10) pounds or over.—Sec. 2.

6.—Retail dealers are all persons who sell in quantities of less than ten (10) pounds.—Sec. 2.

7.—Hotel and dining room proprietors, and restaurant and boarding house keepers, are regarded as dealers.—Sec. 2.

8. The license is for a specified location and must be exposed to view in a conspicuous place.—Sec. 2.

9.—Renovated butter cannot be sold from wagons on the streets or from house to house.—Sec. 3.

10.—A sign or signs must be displayed, setting forth that Renovated Butter is manufactured or sold, and posted in a conspicuous place.—Sec. 4.

11.—A placard also must be placed in a conspicuous place on every

counter or table where meals are served to customers, by every restaurant or boarding house keeper or hotel or dining room proprietor, stating that "Renovated Butter" is used or served to customers.—Sec. 4.

12.—A stencil to be furnished by the Dairy and Food Commissioner, to every manufacturer and wholesale dealer in renovated butter, giving the number of the license and the name and address of the holder thereof, shall be used in stamping every package before being sold by the manufacturer or wholesale dealer to the retailer.—Sec. 4.

13.—Every tub, package or parcel containing renovated butter, shall be distinguished on the outside, in a conspicuous place, by a placard with the words "Renovated Butter" in letters not less than one-half inch long, and the placard shall not contain any other words, printing or device thereon.—Sec. 5.

14.—Upon every open tub or package shall also be displayed a sign or placard, with the words "Renovated Butter" printed thereon in letters not less than one-half inch long, and when renovated butter is sold from such package, before being delivered to the purchaser, it shall be wrapped in a wrapper plainly stamped on the outside thereof with the words, "Renovated Butter," in letters one-fourth inch square, and the wrapper shall contain no other words or printing thereon, and the words shall be kept in plain view.—Sec. 5.

15.—Manufacturers and wholesale dealers in Renovated Butter, shall keep a book in which every sale and shipment shall be entered, giving the quantity and person to whom sold and shipped, the place to which shipped and the name of the transportation line by which shipped, which book shall be open to examination by the Dairy and Food Commissioner, his agents, attorneys and representatives.—Sec. 6.

16.—Retail dealers also shall keep a book, which shall be open to the inspection of the Dairy and Food Commissioner, or his agents, in which shall be entered the date of the receipt of all purchases of Renovated Butter, made by him, and stating where, and from whom purchased, and the quantity.—Sec. 6.

VINEGAR.

Act of June 18, A. D. 1897.
Amended May 21, A. D. 1901.

1.—Vinegar sold as "apple" or "cider" vinegar must be the legitimate product of pure apple juice. No foreign substance, drugs or acids can be introduced.—Sec. 1; Act 21st May, 1901.

2.—Vinegar branded "Fruit Vinegar" must be made wholly from grapes, apples or other fruits.—Sec. 1; Act 21st May, 1901.

3.—Vinegar made by "fermentation" or "oxidation" not distilled shall be branded "fermented vinegar," with the name of the fruit or substance from which it is made.—Sec. 2; Act 21st of May, 1901.

4.—Vinegar made wholly or in part from distilled liquor, must be branded "distilled vinegar."—Sec. 2; Act 21st of May, 1901.

5.—Distilled vinegar must be free from coloring matter and must contain not less than four per centum, by weight, of absolute acetic acid.—Sec. 2; Act 21st of May, 1901.

6.—All vinegar must be made from the fruit or grain from which it is represented to be made and shall contain no foreign substance, except an amount of spice necessary for flavoring, provided the spices do not color the vinegar.—Sec. 2; Act 21st of May, 1901.

PART III.

FOOD DEFINITIONS AND STANDARDS.

MEAT.

1.—MEAT is the dressed and properly prepared edible parts of animals, in good health at the time of slaughter, and of the kind designated.

2.—Refrigeration is the only method of preservation allowable for fresh meats.

3.—CANNED MEATS shall contain no preservative other than salt, sugar and salt-petre, except smoked meat, which contains the products added by the process of smoking.

4.—PICKLED AND SALTED MEATS shall contain no preservatives other than salt, sugar, salt-peter, vinegar, spices or other condiments.

5.—SAUSAGE must be prepared from meat of the quality above indicated, and must contain no preservatives other than sugar, salt, salt-peter, smoke and condiments; artificial color must not be introduced without notice of the fact.

6.—MEAT EXTRACTS must be true to name. No antiseptic, other than salt, may be used.

MILK AND BUTTER.

1.—MILK is the normal secretion, taken by complete milking, from the udder of a healthy cow, properly fed and kept. Colostral milk is excluded.

2.—CREAM shall contain not less than 15 per centum of butter-fat.

3.—SKIM-MILK, except in cities for which a different standard has been established by law, shall contain not less than 8.5 per centum of total solids not fat, and shall be free from all kinds of additions.

4.—BUTTER-MILK. The acid fluid of milk or cream left after the removal of the butter fat by churning. It must be free from preservatives other than the salt employed in the manufacture of butter.

5.—Condensed milk shall be prepared from pure and wholesome normal milk, by removal of water by evaporation; sugar may be added, but no other substances.

6.—Butter must contain not less than 83 per centum of butter-fat.

FRUIT PREPARATIONS.

1.—Fruit-butter must be prepared wholly from the designated fruit without addition of any substance other than cider, glucose or cane-sugar and spices.

2.—Fruit preserves, jams, marmalades and jellies must be prepared from the designated fruits and cane-sugar, with or without the addition of glucose, but without the addition of any other substance.

3.—Fruit juice, fresh, is the juice, or pulp, or both, of fresh, sound fruit of the variety specified on the label, without addition of any other substance.

4.—Fruit juice, sweet, is fresh fruit juice to which sugar or glucose has been added.

SACCHARINE PRODUCTS.

1.—Molasses is that part of the cane juice, or sugar solution, that is left upon the removal of part of the sugar. It must contain no added substance.

2.—Syrup is the purified or evaporated juice of the cane or maple sap, insufficiently evaporated to cause crystallization of the sugar. It must contain no added substance.

3.—Glucose is the solid, sweet, purified substance obtained by the action of acid on starch. It must be free from intermediate products.

4.—Glucose syrup, is syrup obtained by the action of acid on starch.

5.—Honey is the nectar of flowers and saccharine exudations of plants, gathered by bees. Honey made by feeding bees sugar, glucose, syrup or other saccharine substances, is not considered pure honey. The mixing of sugar, syrup, glucose or other similar substance with honey, is considered an adulteration.

SPICE AND CONDIMENTS.

1.—ALLSPICE OR PIMENTO, is the dried fruit of *Pimenta officinalis*.

2.—BLACK PEPPER is the dried, immature berry of *Piper nigrum*. Pepper shells, pepper dust, and other by-products from pepper are adulterants.

3. WHITE PEPPER is the dried mature berry of *Piper nigrum* from which the outer, or the outer and inner coatings have been removed.

4.—CAYENNE PEPPER, red pepper, is the dried fruit of *Capsicum fastigiatum*, *C. frutescens*, *C. baccatu m* or other small-fruited species of *Capsicum*.

5.—CINNAMON is the dried bark of any species of the genus *Cinnamomum*, from which the outer layers may or may not have been removed.

6.—GROUND CINNAMON OR GROUND CASSIA: A powder consisting of cinnamon, cassia buds or a mixture thereof.

7.—CLOVES are the dried flower-buds of *Jambosa*, *caryophyllus*; should contain no more than 5 per cent. of clove stems.

8.—GINGER is the washed and dried or decorticated and dried rhizome of *Zingiber officinale*. Ground ginger shall not contain any added substance, but whole ginger coated with carbonate of lime may be sold as limed or bleached ginger.

9.—HORSE-RADISH the root of *Cochlearie armoracia*: the grated or ground horse-radish may be mixed with vinegar, but with no other foreign material.

10.—MACE is the dried arillus of *Myristica fragrans*; *Macassar* or *Papua mace* the dried arillus of *M. argenta*, should be sold under its own name; *Bombay* mace, *M. Malabarica* has no spice value and is therefore an adulterant.

11.—MUSTARD: SEED, the seeds of *Sinapis alba* (white mustard), *Brassica nigra*, (black or brown mustard). *S. juncea* (sarepta mustard).

12.—MUSTARD: GROUND, is the powdered mustard seed, of one or more varieties, with or without the removal of the hulls and a portion of the oil, but without addition of any other substance.

13.—NUTMEG is the dried seed of *Myristica fragrans*, deprived of its testa; ground nutmegs should contain no added substance; "liming" whole nutmegs is not to be considered an adulteration.

FLAVORING EXTRACTS.

1.—LEMON EXTRACT shall contain at least five per centum of the pure oil of lemon dissolved in alcohol.

2.—VANILLA EXTRACT is the solution prepared by the maceration of the vanilla bean with alcohol and sugar.

TABLE BEVERAGES.

1.—TEA is the dried leaves of *Thea sinensis* or other species of *Thea*, without addition of the leaves of other plants or of coloring materials injurious to health, and without having been exhausted by steeping or other means.

2.—COFFEE is the fruit of *Coffea arabica*. "Roasted coffee" is coffee that has been subjected to dry heat to develop the aroma.

3.—CHOCOLATE is the ground pulp of the roasted seeds of *Theobroma cacao*, from which none of the fat has been removed.

4.—COCOA is the ground pulp of the roasted seeds of *Theobroma cacao* from which a part of the fat has been removed, but to which nothing except the usual flavoring material has been added.

5.—The addition of sugar to either chocolate or cocoa should be indicated on the label.

PENNSYLVANIA'S ROAD SYSTEM.

By HON. JOHN HAMILTON, *State Secretary of Agriculture, Harrisburg, Pa. Delivered before the International Good Roads Congress, Buffalo, Sept. 16, 1901.*

In Pennsylvania we have been endeavoring to get State aid, and we have reached the point where the people of the State, as a rule, believe that State aid is the only solution of the road question.

I think that in the discussion of this subject, we ought to take into account, the difference that exists in the several States, as to the methods of taxation. I understand that in the State of New York real estate is taxed for State purposes, so that when the State makes an appropriation for a road, it simply returns to those who own real estate, some of the money that they have already contributed. In Pennsylvania it is different. We have no tax on real estate for State purposes, and the appropriation that is made by the State legislature comes from corporations and other sources of income that are general, and does not fall upon real estate owners at all, but on personal property, money at interest, etc. Thus in Pennsylvania, State aid to the townships, the agricultural districts, means receiving money from the State by country people, *which they did not contribute*, but which came from other sources. Now, I believe that these other interests, which are taxed, are just as much interested and just as much benefited, by the improvement of the roads through the country districts, as the country people themselves, and that it is not a bonus or a gift to the country people to provide this State aid from this fund, but it is simply an investment, on the part of the State, for the improvement of all of the interests of the Commonwealth. State aid, has now come to be regarded in Pennsylvania, as an essential feature of any system of road improvement. There is no difference of opinion on that point, and we should have had it before this. In the legislature of 1897 there would have been no difficulty in obtaining an appropriation of $1,000,000 for the construction of public roads, had it not been that our capitol had just been destroyed, and immediate provision had to be made for its reconstruction; therefore it was impossible to secure the money, at that time, for good roads. I speak of that time, because at that particular session of the legislature, the good roads law of Pennsylvania was enacted, and there was attached to the bill, a proviso, which

has rendered it inoperative—that $1,000,000 should first be appropriated, before the act could go into effect. So we have on our statute book, a law, which we believe is in good form, and will give us good roads in Pennsylvania, as soon as it can go into effect. It could not go into effect at the time of its passage for the reason I have stated. At the session of the legislature two years ago (we have biennial sessions) the finances of the State were in such a condition that it was impossible to get the money, and at the last legislature, there were other interests involved, which prevented our getting the money.

But Pennsylvania is going to have State aid, and I believe it will come at the next session of the legislature. We had to appropriate $4,000,000 for a State capitol, and we have been paying some debts that were on the Commonwealth, and this has kept back the appropriation of money for State aid. We are putting money, by hundreds of thousands of dollars into forests, and the purchase, by the State, of waste lands. That is on our hands, so that at present the funds of the State seem to be demanded for other purposes. We had also to add to the $11,000,000 appropriated for public schools, another million dollars, which was taken out of the last appropriation. Altogether the State has been loaded down with appropriations that had to be met, and the matter of roads has been left in obeyance. As I say, I believe it will come, at the next session of the legislature, two years hence. When it comes, there will come with it, in the bill to which I have referred, a feature that I believe must be the foundation of any and every system of good roads, wherever goods roads are to be secured, namely, competent supervision. Before State aid and before anything else can be done, and paramount to all, there must be *competent supervision.* [Applause.] It is the greatest folly to appropriate money, to go to men, who are incapable of expending it judiciously. Much as I am interested—I have said it repeatedly to members of the legislature and to our citizens—much as I am interested in good roads in Pennsylvania, if I were in the legislature, and $1,000,000 or $5,000,000 were to be given for public roads, and its appropriation depended on my vote, under our present system of supervision, I would vote "No." [Applause.]

What is the system of supervision? It is simply of such a character as exists in many of the States, in which the selection, not of the fittest, but of the most unfit, are made. By it men are selected, who are willing to stand out on the public roads for a dollar and a half a day, and watch two or three other men do nothing. So the first thing is to select men of intelligence, and we have in our Commonwealth, as in the other States, plenty of men who have the information, or who have the capacity for the acquirement of information, in regard to this matter. If we should select our

best and most capable citizens for road officials, we would have a corps of supervisors in Pennsylvania equal, if not superior, to that of any other State in the Union.

This law of 1897, of which I speak, provides just that. It it not a good roads law; it is simply a supervisor's law. It provides, that there shall be three supervisors elected in each county in the State, and they shall form a board and serve three years, one man going out each year and leaving two of the old members in. It is a continuous board; it never closes its account; is always in existence, and always on duty. [Applause.] Thus the majority of these men will be men having at least one year's experience.

I have tried to educate supervisors. That is what they said I should do, and that is right. But you must have some person that you can educate to begin with, then you must have a little time in which to educate him, and then you must have the services of the man after he is educated. We have over 3,000 supervisors in our State, and I secured the names of every one of them and sent literature to them. At the close of the year, in most of the districts, the supervisors go out of office and a new set of men come in, so that the work you have done with the previous board is practically lost, and you have a new set to deal with, more ignorant perhaps than the others, at least less informed on road matters, and you begin over again. The board provided for under the act has this advantage, that its information is hereditary; it is transmitted from year to year, and it is cumulative in its character. You educate a board of supervisors, and although a man goes out, the information is retained, and in the course of a few years the board is fairly well educated. Instead of having a system of retrogression you have one of progression and accumulation. That is what we need in road matters. We have not yet reached the perfection of road improvement and road instruction. Until within the last twenty years our engineers did not know how to build a good road; now they are beginning to learn how a road can be built. But we must teach the supervisors, in all the districts, how to construct a good road, and after it is constructed, how to maintain it, which is of equal importance.

I believe that we must have in every locality a board of intelligent men, educated in road matters, which will have charge of the roads in that community and look after them; a board that is continued and can be instructed, and which will secure the best information that is to be had on the subject. Then State aid should follow. Give State aid to such a board, and the money of the State will be spent intelligently. Instead of wasting millions of dollars, as is done to-day, without improving the roads at all, every dollar expended in the future will bring a dollar's worth of service, and after it is

expended, we shall have a guaranty that there is somebody to look after it, and see that the work which has been done is not obliterated in a single year. That means constant supervision. Our new law provides that this board of supervisors shall do no work on the road at all; nor shall it oversee men who work on the road. These boards accordingly may be made up of lawyers, physicians, ministers, professional men, business men, farmers; anybody can be on this board. We are after brains; that's what we want. [Applause.] The members of this board get no pay excepting $1.50 for each time they meet, and that can not amount to more than $51 a year, because the board is only required to meet once a month.

Then as to looking after the road. Under this law the roads in the townships are put into districts, of so many miles to a district, and over that district a road master is put, who is a hired man, hired by this board of supervisors. That man understands road building, understands road-making appliances, and he obeys instructions. He is under no obligation whatever to the men who work under him, but is responsible simply to a board of supervisors, and his position depends upon whether he obeys their orders or not. Under our present supervision, the supervisor is the man who is elected, and who wants to be elected the next time; therefore, men and boys at work on the public roads, are allowed to waste their time and the township money, and this supervisor can not protest because he wants a re-election. Instead of having a man who is under obligations to the men who work under him, and owes his position to them, we put a man there who is independent of them, and who can insist that a day's work be done, or else the workman get off the road and pay his road tax in money. This bill provides also that at least one-half the road tax shall be paid in money, and we hope, when it goes into effect, that if a day's work is required of every man for a day's wages, the man will prefer to pay that in money rather than do the day's work. Then we can hire men to work upon our public roads.

One of the duties of the Road Master, under the act, is to be on the road every day of the year excepting Sundays. He is also responsible for his section, and the Supervisors of the district, supervise with a horse and buggy.

I have not time to go into this fully, but State aid will come just as soon as you have in each township men who are instructed, and capable of expending the money. We hope to have it soon in Pennsylvania.

We have made some improvements in our system already. Since the beginning of road agitation, we have had what is known as County roads. The citizens of a county may petition the grand jury for a county road, designating its limits. That petition must be acted upon favorably by two grand juries before any further action

can be taken. Then the county commissioners are authorized to build the road and use for that purpose county taxes. In our State personal property, certain kinds, as well as real estate, are taxed for county purposes. Many communities are taking advantage of that law. They are building some fine roads in the county of Allegheny. But that law seems applicable, only in counties in which there are large cities, and where the amount the city contributes, will be of assistance to the country people. It can be truthfully said that the country people can not be taxed any more for roads than they are at present. We are spending in the country districts of our State about $4,000,00 per annum for roads. We have altogether about 100,000 miles of country roads.

We have a law, which is now two years old, which forms townships of the first and second class. Townships of the first class, have a government, very similar to cities or boroughs, and there the road question is settled. But they can only be formed in districts where the population is dense, and road improvement is a simple matter in those localities. But the great difficulty is found in townships of the second class, where the population is sparse. There the country people are utterly unable to build roads as they should be built, so they must look to the State. At the last legislature we did a thing which looks like a very simple thing, and perhaps you gentlemen from the prairie States may not known how much it means. We passed a law which requires the supervisor to pick the stones off the roads once a month during the summer months. If he does not, he can be arrested and fined. The legislature passed another law last winter which is a great law for every State in the Union, and that is the wide-tire law. [Applause.] When you have got your good roads you must stop the use of narrow tires, and you people in New York should make it a penal offense for a man to go on your roads with a load of over 2,000 pounds, with a narrow tire, or you will have no roads. [Applause.]

COMMERCIAL FEEDING STUFFS IN PENNSYLVANIA.

AN INVESTIGATION BY THE DEPARTMENT OF AGRICULTURE OF PENNSYLVANIA IN CO-OPERATION WITH THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION.

BY WILLIAM FREAR, PH. D., *State College, Pa.*

The chemist in his examination of cattle foods, separates them into several principal groups of materials:

1. *Moisture.*

2. *Ash*, the mineral matter of the food that is left when it is burned.

3. *Protein*, the total nitrogenous material of the food, which is assumed to be entirely composed of substances like the white of egg (albumen) in their chemical and nutritive properties, and called *albuminoids* from this resemblance; but, in point of fact, in many foods, particularly the green and immature leaf and stalk crops and the root crops, a large part of the nitrogenous material is composed of crystallizable substances (non-albuminoids) of quite different nutritive value. The mature grain and stalk contain comparatively little of the non-albuminoids.

4. *Fiber*, the woody matter, forming the framework of plants.

5. *Nitrogen-free extract*, including starch, sugars, gums, plant acids, etc. This group with the fiber composes the carbohydrates of the food.

6. *Fats*, or more properly, the ether-extract. This is determined by extracting the dry food with ether, which takes out the fat with more or less of other materials; from the grain, little else; but from leaves, stalks, etc., relatively large quantities of coloring matters, waxes, etc.

Before any of these substances can be used, they must be dissolved by the digestive fluids of the mouth, stomach and intestines and taken up into the body. This process of solution and absorption is called *digestion*. The degree to which any of the above groups of food constituents is digested depends both upon the nature of the animal using the food, the nature of the individual substances of

which the group happens to be made up in a given food, the mechanical condition in which it exists and the proportion which the group under consideration bears to the other groups of food substances present in the digestive tract at the same time. Thus, so-called "herbivorous" animals provided with a paunch, have greater power of digesting fiber than is possessed by animals with a single, small stomach like the hog; the tender fiber of young plants, is more digestible than the hard, ligneous fiber of old, woody plants; the proteids of clover and timothy seeds are really quite digestible, but escape digestion in a horse's stomach, because the hard seed-coats of these small seeds fail to be broken by the animal's teeth and almost entirely prevent access of the digestive fluids to the proteids; and finally, the digestibility of protein is decreased when large quantities of carbohydrates are present in a ration. The percentage of a given group of materials that is removed from a given food by digestion is termed its *percentage of digestibility*, or sometimes, its *coefficient of digestion*.

The more important nutritive uses of the digested parts of these several food constituents may be briefly noted:

The ash materials supply the mineral salts of the bone, blood, muscle and other animal tissues.

The carbohydrates (fiber and nitrogen-free extract) and fat serve, when burned in the body, to maintain its temperature and supply of energy. For this purpose, the fat is 2.25 times as valuable as the carbohydrates. Both of these groups are also capable of forming body-fat. The protein alone is able to supply the nitrogenous substances forming the organic matter of bone, blood, muscle, nerve, skin, wool, milk-curd and egg-albumen.

To permit a more perfect distinction of food values in the commercial feeding stuffs, the average composition of a number of the more common cattle food products of a Pennsylvania farm is given below:

Composition and Nutritive Ratios of Farm Feeds, Pennsylvania.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Nutritive ratios.
Green Forage:							
Pasture grass, ...	73.37	2.46	5.82	4.85	11.81	1.69	1: 3.7
Timothy in blossom, ...	65.10	2.00	2.80	12.60	21.50	1.30	1:14.4
Clover in bloom, ...	72.70	2.20	4.30	6.50	13.40	0.90	1: 5.0
Hungarian grass in bloom, .	62.70	2.16	3.22	10.78	20.08	1.06	1:11.6
Soiling rye, ...	76.60	1.80	2.60	11.60	6.80	0.60	1: 5.7
Soiling oats, ...	62.20	2.50	3.40	11.20	19.30	1.40	1: 9.1
Soiling corn, kernels glazed	73.40	1.50	2.00	6.70	15.50	0.90	1:15.1
Corn silage, ...	79.10	1.40	1.70	6.00	11.10	0.80	1:16.5
Cured Forage:							
Corn stover, ...	42.20	2.70	4.50	14.30	34.70	1.60	1:17.4
Timothy hay, ...	14.20	4.40	5.20	28.10	44.60	3.00	1:16.2
Red clover, ...	20.90	6.60	11.50	24.70	33.00	3.30	1: 6.0
Hungarian grass, ...	7.70	6.00	7.50	27.70	49.00	2.10	....
Wheat straw, ...	4.60	9.20	3.40	38.10	43.40	1.30	1:65.5
Rye straw, ...	7.10	3.20	3.00	38.90	46.60	1.20	1:69.2
Oat straw, ...	9.20	5.10	4.00	37.00	42.40	2.30	1:32.8
Buckwheat haulm, ...	9.90	5.50	5.20	43.00	35.10	1.30	*
Roots:							
Potatoes, ...	78.90	1.00	2.10	0.60	17.30	0.10	1:17.4
Mangel-wurzels, ...	90.90	1.10	1.40	0.90	5.50	0.20	1: 4.9
Sugar beets, ...	86.50	0.90	1.80	0.90	9.80	0.10	1: 6.8
Turnips, ...	90.50	0.80	1.10	1.20	6.20	0.20	1: 7.7
Rutabagas, ...	88.60	1.20	1.20	1.30	7.50	0.20	1: 8 5
Grain:							
Dent corn, kernel, ...	10.60	1.50	10.30	2.20	70.40	5.00	1:12.1
Oats, ...	11.00	3.00	11.80	9.50	59.70	5.00	1: 5.8
Rye, ...	11.60	1.90	10.60	1.70	72.50	1.70	1:11.0
Barley, ...	10.90	2.40	12.40	2.70	69.80	1.80	1: 8.0
Wheat, winter, ...	10.50	1.80	11.80	1.80	72.00	2.10	1: 9.9
Buckwheat, ...	12.60	2.00	10.00	8.70	64.50	2.20	1: 7.0

* No data on record.

By the term *nutritive ratio*, is meant the proportion which the protein bear to the starch equivalent of the nitrogen-free extract, fiber and fat in the digestible portion of any food-stuff, the protein being taken as 1. This starch equivalent is calculated by the addition of the quantities of digestible nitrogen-free extract and fiber to two and one-fourth times the quantity of digestible fat; this increase in the case of the fat being due to its exceptional heat producing power, to which reference has already been made.

The results of many decades of farm experience and of recent accurate scientific investigations show that the value of a ration to produce a specific result, such as the development of the young animal, the production of lean meat, or of fat, the enlarged or continued flow of milk, or, especially, working capacity, depends very materially upon the nutritive ratio of the food consumed.

As illustrations of the ratios found in foods that experience has proven to possess especial value for the several purposes above mentioned, the following may be cited:

1. Oxen at rest in the stall, ... 1:12.0
2. Fattening oxen, main period, ... 1:5.5
3. Fattening swine, main period, ... 1:6.0
4. Growing cattle, 2 to 3 months old, ... 1:4.7
5. Growing cattle, 18 to 24 months old, ... 1:8.0
6. Milk cows, ... 1:5.4
7. Wool sheep, finer breeds, ... 1:8.0
8. Horses, moderately worked, ... 1:7.0
9. Horses, heavily worked, ... 1:5.5

Comparison of these ratios with those of the feeding stuffs of domestic production at once shows that so long as pasture is abundant, growing animals, milk cows and work horses can readily secure the food fitted for their use. In the earlier days of American agriculture, little more than mere maintenance of farm animals was attempted during the winter months. For this purpose, the hay of timothy and other true grasses, corn stover and oat straw as roughage and corn and the more costly oats as grains, served excellently well; the latter grain being chiefly reserved, however, for the feeding of driving horses and possibly the family cow. The problem of securing a fitting food is much more difficult, however, in these days of intensive farming with restricted pasturage areas; of winter dairying with the consequent winter feeding of the calves that are reserved for raising; and of increased demand for lean as contrasted with fat meat.

The use of the process of ensilage in connection with intensive farming and winter dairying has ensured a supply of succulent food with valuable dietetic results, but, as it is usually conducted, has not materially improved the nutritive ratio of the average ration. The employment, also, of immature soiling crops in the spring and early summer, at a time when pastures are not yet ready to receive the herds and flocks, has reduced somewhat the period during which the wide-ratio roughage must chiefly be relied upon. The substitution of roots for any large portion of the ration is not esteemed practicable with the small animals preferred in America for dairy purposes, because of the bulky nature of the food, as well as because of its comparatively high cost. The use of clover and similar legumes for the purpose of securing narrower nutritive ratios in the rations of working, growing and milk-producing animals has very largely increased, with highly advantageous results in quality and yield of product; but a limit is speedily reached in practice beyond which the substitution of clover for corn stover or corn silage and for a portion of the grain food is not advantageous to the animal and is not economical of the entire product of any known general system of farming in America, where the corn crop is so important a part of every widely accepted rotation

Consequently, there has arisen, within the last few decades, an increasing demand for concentrated feed stuffs—that is, such as are of relatively little bulk and are, in very large measure, digestible—more especially, for such as are rich in protein. To supply this demand, a great trade in such materials has developed; the centralization of the milling operations of the Northwest has resulted in the formation of large stocks of wheat by-products for which the grain farms of the West offer no market, but which move readily eastward to the points of greater demand. The introduction of new methods of manufacture has made possible the utilization for distant markets of the by-products from the manufacture of beer and spirituous liquors, of starch, glucose and cereal breakfast foods, so that to-day the farmer has offered for his use not only large quantities of concentrated feed stuffs, but materials of great variety of source, composition and dietetic value.

It is not the purpose of this bulletin to discuss the nutritive and dietetic values of the several materials, but rather to briefly consider their nature and the composition which they exhibit in the Pennsylvania markets; especially to determine the variations appearing in the amounts of important constituents and to compare them with those observed in New York and New England. For New York, New Jersey, Maine, Massachusetts, Rhode Island and Connecticut have required that dealers in such materials shall stamp upon the packages containing them a guarantee of composition, analogous to that which most States require from dealers in fertilizers, and have provided for a control analysis of the feeding stuffs.

The samples whose analyses are recorded below were taken by agents appointed by the State Department of Agriculture, and the analytical work has been performed under the direction of the writer, by Messrs. M. S. McDowell and M. H. Pingree, Assistant Chemists of the Experiment Station, in accordance with arrangements made between the Secretary of Agriculture and the Advisory Committee for the Experiment Station. For the purposes of this examination, determinations of the protein and fat were all that were deemed necessary in most cases. These determinations were made by the official methods, except that the feeding stuffs were not dried in a current of hydrogen.

The fact that the analytical examination has been confined in most instances to these two indicative constituents, must not be made a ground for disregarding in the selection of market feeding-stuffs, the nutritive value of the fiber and other carbohydrates, nor further must it be assumed that concentrated feeds, though different in the quantities of carbohydrates they contain, are essentially alike as regards the nutritive quality of these constituents. In general, starch and sugar are more highly digestible than fiber, gums and

related materials and probably have, for equal quantities of digested substance, a higher nutritive effect. The following table compiled by Jordan and Jenter,* well presents the more striking differences:

Carbohydrate Relations in Dry Matter of Several Feeding Stuffs.

	Sugars and starch.	Total nitrogen-free extract.	Sugars and starch in nitrogen-free extract.	Digestibility of the nitrogen-free extract.
Wheat, entire grain, Stone,	57.9	77.7	74.6	....
Wheat, entire grain, Wiley,	72.5	78.5	92.4	....
Maize, entire grain, Stone,	66.0	78.0	84.6	93
Oats, entire grain, Wiley,	50.9	66.3	76.8	83
Mixture, maize and oats, equal parts,	58.4	72.1	81.0	....
The Gluten Products:				
Gluten meal,	38.2	49.8	76.7	93
Buffalo gluten feed,	27.3	58.3	46.8	84
Davenport gluten feed,	29.8	60.9	48.9	....
Diamond gluten feed,	31.6	61.6	51.3	....
Joliet gluten feed,	34.0	66.0	51.5	....
Peoria gluten feed,	28.9	59.8	48.3	90
The Oil Meals:				
Cotton seed meal,	16.0	27.9	57.4	50
Linseed meal, old process,	13.2	29.2	33.7	78
Linseed meal, new process,	20.8	40.8	51.0	84
Malt sprouts,	23.1	49.6	46.6	69
Buckwheat middlings,	27.3	48.2	56.5	....
Wheat bran,	23.6	60.5	39.	69
Wheat middlings,	38.8	64.2	60.4	85
Hominy feed,	50.1	72.7	68.9	....
H. O. dairy feed,	34.6	60.4	57.3	....
Oat feed,	29.4	61.5	47.8	60
Victor feed,	43.0	70.3	61.2	....
Chop feeds,	47.5	73.5	64.6	....
X oat feed,	16.1	57.9	27.8	....

In the presentation of the results of their work, the Massachusetts and New York Stations have followed a classification of feeding-stuffs based upon their composition. The modified form adopted in New York is as follows:

Class I. Thirty to 45 per cent. protein and 50 to 60 per cent. carbohydrates, including cotton-seed meal, linseed meal and the gluten meals, such as the Chicago, King, Cream and the Hammond.

Class II. Twenty to 30 per cent. protein and 60 to 70 per cent. of carbohydrates, including gluten feeds, such as the Buffalo, Golden, Diamond, Davenport, Climax and Standard, as now made, Atlas meal, dried brewers' grains, malt sprouts, buckwheat middlings and peas and beans.

Class III. Fourteen to 20 per cent. of protein and 70 to 75 per cent. of carbohydrates, including brans and middlings from wheat and rye, certain so-called mixed feeds of a proprietary character, these being in part oat feeds fortified with some more highly nitrogenous material.

*Bulletin No. 166, N. Y. Agricultural Experiment Station, Geneva, p. 262.

Class IV. Eight to 14 per cent. of protein and 75 to 85 per cent. of carbohydrates, including barley, corn, oats, rye, wheat, cerealine, hominy and oat feeds, corn and oat chops, corn bran, corn germ feed and chop feed in general.

For the purpose of this bulletin it is, however, preferred to discuss these products in relation to the raw materials from which they are severally derived.

COTTON-SEED MEAL.

This is manufactured from the seed of the cotton-plant. The seed is tufted by a thick coat of lint, which is exposed, as the plant ripens, by the opening of the boll or pod. The lint which forms the cotton of commerce is removed from the seed by the operation of ginning, although a considerable quantity of short lint still clings to the seed coat. The proportion of seed in upland cotton* is about 2 to 2.2 pounds for each pound of lint, in sea-island cotton † 2 to 2.5 pounds. The supply of this material is therefore very abundant. The fuzzy seed from the ginning process is then subjected to a rough milling process for the removal of the black hull from the oval seed. The hull is further worked to secure the small amount of lintel adhering. The decorticated seed—that is, that from which the hull has been removed—is then cooked, placed in jute sacks and subjected to heavy pressure in powerful hydraulic presses, whereby a portion of the oil is expressed. The press cakes, the "cotton-seed cake" of commerce, are afterward fine ground, yielding the cotton-seed meal. The average theoretical yield, as compared with the average milling product, is as follows:‡

	Theory, per cent.	Mill product, per cent.
Oil,	20.00	12.5
Meal,	30.00	37.5
Hulls,	40.00	48.9
Lintel,	10.00	1.1
	100.00	100.00

* McBryde, Bulletin Tenn. Agr. Exp. Sta., Vol. IV, No. 5, pp. 127 and 129.

† Shiver, Bulletin, S. C., Agr. Exp. Sta., No. 47, p. 34.

‡ Statistics of X Census: Quoted in Bulletin Tenn. Agr. Exp. Sta., IV, No. 5, pp. 128-9.

These figures clearly show that fully 37.5 per cent. of the seed-oil remains in the press-cake and that the recovery of the lintel from the hull is very imperfect, being barely one-ninth of the amount present.

The relative composition of the undecorticated seed, the hull and the cotton-seed meal are as follows:*

	Seed, per cent.	Hull, per cent.	Meal, per cent.
Moisture,	7.71	11.30	7.47
Composition of dry matter:			
Ash,	3.40	3.30	7.60
Protein,	16.81	5.19	51.12
Fiber,	28.27	43.85	4.90
Nitrogen-free extract,	31.70	45.31	26.37
Fat,	19.82	2.35	10.01
	100.00	100.00	100.00

Hand-separated hulls contain only half as much protein and one-fourth as much oil. The milling operation results in a tearing away of a portion of the true kernel with the hull.

Good cotton-seed meal is yellow in color with a greenish tinge and possesses a pleasant nutty odor. On aging, it darkens, especially under conditions rendering it rancid or musty. Dark color indicates a possible admixture of black cotton-seed hulls, but not all dark colored samples are thus adulterated. Another impurity reported is an admixture of wastes from rice mills.

At a recent convention in New Orleans, the cotton-seed oil producers adopted the following rules:

"17. A ton of cotton-seed meal is 2,000 pounds, unless otherwise stated. A sack of cotton-seed meal is 100 pounds gross weight.

"Cotton-seed meal shall be classed and graded as follows:

"18. Choice. Must be the product from choice cotton-seed cake when finely ground, must be perfectly sound, sweet and light yellow color (canary), free from excess of lint and hulls. Analysis must contain at least 8 per cent. of ammonia.

"19. Prime. Must be made from prime cake, finely ground, of sweet odor, reasonably bright in color, yellow, not brown, or reddish, and free from excess of lint or hulls and by analysis must contain at least 8 per cent. of ammonia.

"20. Off. Any cotton-seed meal which is distinctly deficient in any of the requirements of prime quality, either in color, odor, texture or analysis, or all."

* Bulletin Tenn. Agr. Exp. Sta., IV, No. 5, p. 144.

The following samples of cotton-seed meal were taken in Pennsylvania, this season, by Department agents:

No.	Name of Brand.	Manufacturer.	Dealer.	Price per ton.
147	Cotton-seed meal, ...	American Oil Co., N. Y. City,	Snyder Bros., Dalton Pa., ...	$26 00
32	Cotton-seed meal, ...	E. B. Williams & Co., Memphis, Tenn.	J. P. Sandt, Easton, Pa., ...	30 00
125	Cotton-seed meal, ...	E. B. Williams & Co., Memphis, Tenn.	C. H. Sears, Clark's Summit, Pa., ...	27 00
209	Cotton-seed meal, ...	E. B. Williams & Co., Memphis, Tenn.	Wm. Fisher, ...	27 00
93	Cotton-seed meal, ...	....	J. Watson Craft, Ambler, Pa., ...	30 00
106	Cotton-seed meal, ...	....	Maryland Grange Agency, Balto., Md., ...	26 00
110*	Cotton-seed meal, ...	....	Morris Briggs, Woodburn, ...	27 00
111	Cotton-seed meal, ...	....	Trenton Milling Co., Morrisville, ...	27 00

* Musty, having become damp in the warehouse.

Their percentage, composition and other data for comparison are given below:

Number.	Moisture.	Protein.	Fat.	Remarks.
147, ...	6.41	42.50	12.25	
32, ...	6.76	46.69	9.28	
125, ...	7.62	45.25	9.82	
209, ...	7.34	44.69	10.06	
93, ...	8.88	43.69	8.77	
106, ...	7.09	44.50	9.89	
110, ...	7.11	43.31	11.26	
111, ...	6.91	44.56	9.48	
Avaerge, ...	....	**44.40**	**10.10**	

Microscopic examination fails to reveal any foreign substances or any distinct excess of hulls; recent New York and Massachusetts examinations have detected such adulteration.

Comparison of these goods with those sold elsewhere may be made as follows:

	Number of analyses.	Protein, per cent.			Fat, per cent.		
		Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Pennsylvania analyses, ...	8	46.09	42.50	44.40	12.25	8.77	10.10
New England analyses, 1898-99, .	205	52.6	40.3	45.4	17.0	6.5	11.2
New York analyses, 1898-99, ...	14	50.69	41.68	45.64	13.16	7.56	10.82

The average superiority of the goods sold in New York and New England in 1898-9, is shown by analyses reported in Bulletin No. 166 of the New York Experiment Station and summarized in Bulletin No. 130 of the Connecticut Agricultural Experiment Station.

LINSEED MEAL.

The seed of the flax plant is also rich in a peculiar oil, possessing in marked degree the power of absorbing oxygen from the air and thereby becoming hard and resinous—a property fitting it especially for use in making paints and oil varnish. The oil is contained, together with an abundance of protein, in the inner portion of the seed, the endosperm, or reserve food-supply for the developing embryo. The flat, shining seeds, dark brown in color, form, if mature, a slimy layer when left in contact with water. This is due to a transformation of the outer layers of the seed-coat into mucilage. One of the dark inner layers of the seed-coat carries considerable tannin. Owing, however, to the other constituents, the seed has a markedly soothing and slightly laxative effect. The composition of the entire seed is, according to Kuehn:*

	Per cent.
Water,	11.8
Ash,	3.4
Protein,	21.7
Fiber,	7.9
Nitrogen-free extract,	19.6
Fat or oil,	35.6
	100.0

There are two general processes for the separation of the oil from the crushed seed. The older process involves the pressure of the seed-meal by hydraulic presses. The operation is more complete when the seed-meal is first cooked, though the oil takes out more resin and coloring matter and, if too high a temperature is reached, the protein is modified and becomes somewhat less digestible. Meals from linseed cake prepared in this manner, are called "old process" meals and rarely, if ever, contain less than 3.5 per cent. of oil, the warm-pressing usually removing but 27 to 28 per cent. of the oil.

*Pott, Ldw. Futtermittel, p. 442-3

The "new process" is one of extraction by means of volatile solvents, such as carbon bisulfid or gasoline, more generally the former. The meal is placed in a large chamber and streams of the solvent are caused to slowly trickle through the mass, dissolving and extracting the oil, which is then recovered by evaporation of the solvent. The extracted meal is likewise freed from all traces of the solvent. Less than 3.5 per cent. of oil is commonly left in the meal, and sometimes less than 2 per cent. In general, the "new process" meal contains about 4.75 per cent. less oil than the "old process" meal and, correspondingly, 2.5 per cent. more protein. There is no ground for the quite frequent belief that there is an injurious chemical left in the meal treated by the extraction process.

The meal, as prepared by either of the above processes, is of a grayish-brown color and contains numerous dark-brown or black particles of the seed-coat.

The following samples were gathered by Department agents for examination:

"Old Process" Meals.

No.	Brand.	Manufacturer.	Dealer.	Price per ton.
229	Linseed meal, dry,	Armstrong & McKelvie, Pittsburg, Pa.	McClelland & Siple,	$35 00
236	Linseed meal, dry,	Armstrong & McKelvie, Pittsburg, Pa.	Byrne & Steele,	40 00
237	Linseed meal, dry,	Armstrong & McKelvie, Pittsburg, Pa.	Charles Friel,	40 00
76	Linseed meal,	Cleveland Linseed Meal Co., Cleveland, O.	Warner Bros., Grant, N. Y.,	33 00
264	Linseed meal,	Cleveland Linseed Meal Co., Cleveland, O.	L. Brant, Harrisburg, Pa.,	30 00
92	Cake meal,	J. Watson Craft, Ambler, Pa.	J. Watson Craft, Ambler, Pa.,	30 00
54	Linseed meal,	Gibson Bros., Philadelphia,	Mahlon C. Dietrich, Kempton, Pa.,	30 00
30	Linseed oil meal,	John T. Lewis & Bros. Co., Philadelphia.	J. P. Sandt, Easton, Pa.,	30 00
275	Linseed oil meal,	A. B. Orr Linseed Oil Co., Pequea, O.	A. S. Somes, Halifax, Pa.,	30 00
246	Linseed meal,	Pain Bros. & Co., Milwaukee, Wis.	D. H. Beebe, Corry, Pa.,	26 90
72	Oil meal,	Thompson & Co., Allegheny, Pa.	King Bros., Uniontown, Pa.,	20 00
74	Oil meal,	Thompson Linseed Oil Co., Pittsburg, Pa.	G. L. Moore, Brownsville,	28 00
212	Linseed meal,	Thompson & Co., Allegheny, Pa.	C. Beckert, Pittsburg, Pa.,	30 00
217	Linseed meal, dry,	Thompson & Co., Allegheny, Pa.	W. H. Cleland, Pittsburg, Pa.,	35 00
234	Linseed meal, dry,	Thompson & Co., Allegheny, Pa.	Peter Bock, Pittsburg,	36 00
239	Linseed meal, dry,	Thompson & Co., Allegheny, Pa.	C. Kellner, Allegheny, Pa.,	30 00
95	Cake meal,	Toledo Mills, Toledo, O.,	W. H. Heebner, West Point, Pa.,	27 00
22	Oil meal,		Penn Traffic Co., Ltd., Johnstown, Pa.,	60 00
25	Oil or cottonseed,		Widman & Sheeler, Johnstown, Pa.,	28 00
130	Linseed oil meal,		Snyder Bros., Dalton,	25 00
132	Linseed meal,		Weston Mill Co., Scranton, Pa.,	25 00
133	Linseed meal,		C. H. Sears, Clark's Summit, Pa.,	32 00
257	Oil meal,		F. L. Heath, Corry, Pa.,	30 00
259	Oil meal,		Bliss & Merrick, Corry, Pa.,	30 00
279	Linseed meal,		C. F. Dyer, Millersburg, Pa.,	30 00

"New Process" Meals.

No.	Brand.	Manufacturer.	Dealer.	Price per ton.
86	Linseed meal,	Cleveland Linseed Oil Co., Cleveland, O.	Simpson Bros., Norristown, Pa.,	$27 00
96	Linseed meal,		W. H. Heebner, West Point, Pa.,	25 00
83	Linseed meal.		Warren Mills Co., Warren, Pa.,	31 00

Analyses of Linseed Meals.

Number.		Moisture, per cent.	Protein, per cent.	Fat, per cent.
	"Old Process" Meals.			
229		8.22	36.13	6.08
236		8.15	34.94	6.37
237		8.54	35.38	5.37
	Average, Armstrong & McKelvie,	(8.30)	(35.48)	(5.94)
76		9.74	32.94	6.61
264		8.43	31.00	6.10
	Average, Cleveland Linseed Oil Co.,	(9.13)	(31.97)	(6.36)
92		9.77	36.31	6.07
54		8.73	30.00	8.60
30		8.02	34.94	6.13
275		8.54	33.56	5.83
246		8.19	37.69	3.63
72		8.94	34.81	5.11
74		8.53	35.00	5.97
212		8.26	35.44	4.00
217		8.80	34.70	3.54
224		7.95	37.81	6.93
239		8.34	37.00	7.09
	Average, Thompson & Co.,	(8.47)	(35.79)	(5.44)
95		9.98	32.06	8.88
22		8.85	34.44	5.71
25		9.14	33.44	5.96
130		8.05	36.50	5.38
132		8.60	29.81	5.26
133		8.28	29.69	7.04
257		8.98	33.75	6.92
259		9.32	14.69	4.39
279		8.51	31.00	6.42
	Range,	7.95-9.98	14.69-37.81	3.54-8.88
	Average, excluding No. 259,	**8.64**	**34.10**	**6.04**
	Average,	**8.67**	**33.32**	**5.98**
	"New Process" Meals.			
86		10.41	34.00	2.19
96		10.31	34.13	2.92
	Average, Cleveland Linseed Oil Co.,	(10.36)	(34.07)	(2.56)
83		9.79	34.63	2.77
	Range,	9.79-10.41	34.06-34.63	2.19-2.92
	Average,	**10.17**	**34.25**	**2.63**

Microscopic examination of these samples shows the presence of no very marked quantity of foreign substances except in case of No. 259. This sample, while it shows the presence of the characteristic tissues of the flax-seed, contains a very large proportion of dark-brown hulls, containing long woody fibers, and of clear white masses not found in flax-seed but like those of buckwheat bran; also, there is a noticeable quantity of chaff. The very low proportion of nitrogen in this sample is such as the substitution of most of the linseed meal by buckwheat bran would render probable.

Excluding this adulterated article, a comparison of these Pennsylvania samples with goods of this kind in general may be made:

	Number of analyses.	Protein, per cent. Highest.	Protein, per cent. Lowest.	Protein, per cent. Average.	Fat, per cent. Highest.	Fat, per cent. Lowest.	Fat, per cent. Average.
Old Process Meal:							
Pennsylvania samples, ...	24	37.81	29.69	34.10	8.88	3.54	6.04
New England analyses, 1898-9, ...	25	38.9	31.8	35.7	9.6	2.7	7.2
New York analyses, 1898-9, ...	11	38.19	28.69	35.74	8.86	5.72	7.19
New Process Meal:							
Pennsylvania samples, ...	3	34.63	34.00	34.25	2.92	2.19	2.63
New England analyses, 1898-9, ...	31	42.2	30.6	38.2	3.5	1.8	2.4
New York analyses, 1898-9, ..	5	37.56	35.19	36.14	4.79	2.91	3.57

Here too, a very marked superiority is observed in the case of the average goods sold in New York and New England.

WHEAT PRODUCTS.

In the course of the manufacture of flour from wheat, bran, middlings and a number of products sold under other names are separated and sold as cattle foods. A brief consideration of the composition of the winter and spring varieties of the grain, of the structure of the wheat berry and of the essential differences in its parts as they are separated by the two prevailing types of milling will be helpful in getting a clear notion of the nature of the several market feeds prepared from this grain.

Jenkins and Winton* several years ago summarized the analyses extant of American winter and spring varieties of wheat, with the following results:

	Winter wheat (262 analyses), per ct.	Spring wheat (13 analyses), per ct.
Moisture, ...	10.5	10.4
Ash, ...	1.8	1.9
Protein, ...	11.8	12.5
Fiber, ...	1.8	1.8
Nitrogen-free extract, ...	72.0	71.2
Fat, ...	2.1	2.2
	100.0	100.0

* Bulletin No. 11, Office of Experiment Stations, U. S. Department of Agriculture.

Richardson* made 208 partial analyses of winter wheats from the Atlantic, Gulf and Middle States and of 33 samples of spring wheats from Minnesota, Dakota and Manitoba; the respective protein averages are 11.47 and 14.07 per cent. These data indicate an average of 13 to 13.5 per cent. of protein for spring wheats, an amount from one to two per cent. greater than that in winter wheats.

The structure of the wheat grain divides it into essentially four principal parts: 1. The epidermis or skin, including the hairs at the tip of the grain and three thin outer layers, weighing collectively about 3 pounds in 100 pounds of grain. 2. The color layer, composed of small cells containing two pigments, a yellowish and a red, according to whose relative predominance the color of the grain is "white," "amber" or "red." This forms 2 pounds in 100 pounds of grain. 3. The germ or embryo, located at the lower part of the grain and connected with a thin layer of tissue entirely enveloping (4) the *endosperm* or inner portion of the grain.

The outer layers are almost wholly composed of woody tissue. The germ is chiefly composed, on the other hand, of protein, oil and certain ash materials. The endosperm is not at all uniform in composition. At the center it is white and powdery, and is composed chiefly of starch enclosed in large, thin-walled cells. But toward the exterior of the mass of endosperm, the starch diminishes in proportion, and albuminoids, fats and ash become more abundant. The laxative materials of the endosperm, probably albuminoid in nature, also increase, relative to the other albuminoids, as the exterior is approached, and among the ash constituents, the lime grows relatively less, the magnesia more abundant.

The process of milling has for its object the powdering of the grain and the removal of the less desirable portions. The germ is removed because flours retaining it, tend, on standing, to darken and become ill-flavored. The outer layers are removed as bran. This is not, however, composed wholly of the epidermis and color layers, but also includes a large proportion of the endosperm, more especially of the outer, albuminoid layers of it. When separately prepared, these outer layers constitute the middlings, a dark flour making a "runny" dough. In general, the milling process commonly yields but 70 to 75 per cent. of flour and 25 to 30 per cent. of bran and middlings, including the germ, as its separation from other byproducts is not common in many mills.

The character and proportion of the several milling products varies, of course, both with the character of the grain and the detailed method of milling. There are three principal methods of milling, two stone-milling processes and one roller process. Formerly, the flour was thoroughly ground by a single run through close-

*Bulletins 4 and 9, Chemical Division, U. S. Dept. of Agric.

set stones; complete purification was not possible by such a process. This was followed by high-milling, in which the grain was coarsely ground between stones less closely set, the fine flour bolted out, and the middlings then reduced by repeated grinding between more closely set stones. This latter process is excellently well adapted to soft winter wheat, but not so well to the harder spring varieties. For these, the roller process is best in which hardened steel rolls are employed to crack the brittle grain, the products of the several breaks being successively bolted as the grain goes between rolls more and more closely set. Besides the milling machinery proper, all good mills are to-day equipped with screening, blowing and brushing machines for the removal of foreign seeds, gravel and dust.

Teller* reports the distribution of materials in several milling operations: A. 7,000 pounds of mixed wheat; mill, 7 breaks, 40 bushels per hour capacity; B. Red wheat and C. Fulcaster, 3,000 pounds of each on a small 4-break mill of 7 bushels per hour capacity.

Yield of Parts in Percentages.

	A.	B.	C.
Patent flour,	12.11	17.65	25.80
Straight flour,	56.63	50.35	42.00
Low grade flour,	3.55	2.32	3.87
Shorts,	....	1.10	....
Dust-room contents,	....	.82	1.17
Bran,	23.37	24.10	23.80
Ship-stuff,	2.48	....	1.13
Tailings,	....	....	.33
Screenings,	1.1	2.70	1.83
Sample taken,	....	.05	....
Loss,	.7	.91	.67

The proportions of "patent" and "straight" flours differ much in the several cases, but the entire yields of good quality flour in the three trials are respectively 68.74, 68.00 and 67.80, figures agreeing excellently well. The quantities of epidermis, germ, etc., classed as bran, also exhibit little difference. The names and proportions of the several minor by-products differ very much, however.

For the composition of the several products, analyses of those of the first two of the above milling tests will suffice:

* Bulletin 42, Arkansas Experiment Station.

Composition of Milling Products from Wheat.

	Grain.	Patent flour.	Straight flour.	Low grade flour.	Shipstuff.	Dust room products.	Bran.	Germ.
A. *Mixed Wheat:*								
Water,	13.90	13.75	13.90	13.22	12.25	....	12.85	6.80
Ash,	2.15	.33	.47	.90	3.12	....	5.80	4.65
Protein,*	12.31	9.69	10.37	12.88	16.36	....	15.56	36.00
Fiber,	2.17	.17	.26	.74	3.55	....	6.14	1.60
Nitrogen-free extract,	63.32	75.01	73.75	70.56	59.02	....	54.45	36.55
Fat,	2.15	1.05	1.25	1.70	4.80	....	5.20	14.38
B. *Red Wheat:*								
Water,	13.70	14.05	14.04	13.90	13.50	13.04	12.55	....
Ash,	1.85	.26	.35	.78	1.21	2.81	5.85	....
Protein,*	11.40	8.49	9.80	13.79	14.82	12.65	6.30	....
Fiber,	2.03	.17	.22	.54	.98	6.06	6.51	....
Nitrogen-free extract,	69.17	76.10	74.32	69.19	66.99	62.29	53.99	....
Fat,	1.85	.93	1.27	1.80	2.50	3.15	4.80	....

*In these analyses estimated as 5.7 times the percentage of nitrogen found.

The five products last named are sold largely or exclusively as cattle-foods, either under the above names or under others.

Red-dog flour is the name given to the poorest grade of flour, so named because it is "off color."

The term "*middlings*" is used by some manufacturers to cover everything except the high-grade flours and bran; in many cases, indeed, a very considerable proportion of bran is included in the product. *Shorts* and *ship-stuff* are terms applying to somewhat varying grades of middlings, the former being, in fact, closely related to bran, but containing less fiber and ash.

The terms *mixed feed* or *wheat feed* are applied to mixtures of middlings, bran and other "wheat offals," and, in some instances, are in part composed of "red dog."

Owing to the wide latitude in the use of the several trade names of milling products, it is clear that the purchaser can have from the name alone, only a very imperfect idea of the composition and nutritive value of the various wheat offals, especially those sold as middlings and as mixed feed.

Furthermore, even in the case of brans, the Connecticut and Massachusetts controls have found a considerable amount of adulteration, admixtures of corn-cob and wastes from broom-corn being introduced. The latter control states that this was particularly true of certain brans brought from Tennessee and Kentucky.

The following samples of wheat products were submitted by Department agents during the current year:

Wheat Grain.

No.	Brand.	Manufacturers.	Dealers.	Cost per ton.
144	Scorched wheat for poultry.	Empire Grain and Elevator Co., Binghamton, N. Y.	Snyder Bros., Dalton, Pa.,	$21 00

Upon analysis, this sample showed:

	Moisture, per cent.	Protein, per cent.	Fat, per cent.
	9.75	12.69	2.01
Average winter wheat,	10.60	11.80	2.[illegible]0

The grain has evidently suffered little deterioration of its nutritive value by scorching.

Wheat Bran.

Of wheat bran, the Department agents submitted 38 samples. In the majority of instances, no designation as to the character of the wheat from which the sample was derived, whether "winter" or "spring," was given. Such brans are grouped together. The samples received were as follows:

No.	Manufacturer.	Dealer.	Price per ton.
	Winter Brans.		
277	C. F. Dyer, Millersburg, Pa.,	L. T. Slight,	$20 00
201	Hunter Bros., St. Louis, Mo.,	Chas. Friel, Pittsburg,	22 00
33	Milton Floury, Walters, Pa.,	C. W. Walter, Walters,	19 00
211	Warwick & Justice, Massilon, O.,	Peter Bock, Pittsburg,	20 00
27	....	Penn Traffic Co., Ltd., Johnstown, Pa.,	20 00
	Spring Brans.		
179	Dwight M. Baldwin, Jr., Graceville, Minn.,	Geo. O. Wilt,	18 00
222	C. A. Foster, Carnegie, Pa.,	McClelland & Siple, Pittsburg,	20 00
262	Full Frank Grain Co., Milwaukee, Wis.,	Cyrus Romberger, Lykens,	18 00
273	N. W. Consolidated Milling Co., Minneapolis, Minn.	A. S. Somes, Halifax,	19 00
281	G. D. Stevens & Co., Minneapolis, Minn.,	A. M. Pike, Halifax,	20 00
134	Washburn, Crosby Co., Minneapolis, Minn.,	Snyder Bros., Dalton, Pa.,	19 00
119	Weston Mill Co., Scranton, Pa.,	Weston Mill Co., Scranton, Pa.,	20 00
266	....	S. B. Vance, Middletown, Pa.,	20 00
268	....	Joseph Burkholder, Hummelstown, Pa.,	19 00

No.	Manufacturer.	Dealer.	Price per ton.
	Brans not Classified.		
105	D. P. Barber & Sons, Minneapolis, Minn.,	W. K. Heebner, West Point, Pa., ...	18 00
176	Bare Milling Co., Roaring Springs, Pa., ..	Bare Milling Co., Roaring Springs, Pa., ...	....
255	Bliss & Merrick, Corry, Pa., ...	Bliss & Merrick, Corry, Pa., ...	18 00
171	Clapper Bros., Martinsburg, Pa., ...	Clapper Bros., Martinsburg, ...	19 00
187	Clapper Bros., Martinsburg, Pa., ...	Clapper Bros., Martinsburg, ...	17 00
248	Densmore Bros., Erie, Pa., ...	Densmore Bros., Erie, Pa., ...	17 00
66	Eclipse Milling Co., Brownsville, Pa., ...	Eclipse Milling Co., Brownsville, Pa.,.	19 50
71	Gaddis Co., Uniontown, Pa., ...	M. H. Clark, Uniontown, Pa., ...	20 00
60	David Hartz, Morgantown, Pa., ...	David Hartz, Morgantown.	19 00
244	Frank L. Heath, Corry, Pa., ...	Frank L. Heath, Corry, Pa., ...	18 00
199	Hunter Bros., St. Louis, Mo., ...	Byrne & Steele, Pittsburg, Pa., ...	20 00
159	F. & I. Mentzer, Frankstown, Pa., ...	F. & I. Mentzer, Frankstown, Pa., ...	18 00
2	Northwestern Milling Co., Minneapolis, Minn.	L. Read, Chambersburg, Pa., ...	17 00
221	Pittsburg Milling Co., Pittsburg, Pa., ...	Wm. Fisher, Pittsburg, Pa., ...	18 00
104	Phi. H. Postal Milling Co., Mascoutah, Ill.	W. K. Heebner, West Point, Pa., ...	19 00
44	Seaboard Milling Co., Reading, Pa., ...	A. N. Kissinger & Son, Reading, Pa.,	19 00
56	Shaffer, Wanner & Cc., Fleetwood, Pa., ..	M. C. Dietrich, Kempton, Pa., ...	19 00
218	J. W. Smith & Co., Pittsburg, Pa., ...	M. E. Coleman, Pittsburg, Pa., ...	21 00
6	Truesdale & Speer, Minneapolis, Minn., ..	Coyle & Diehl, Chambersburg, Pa.. ...	17 00
8	....	B. A. Betts, ...	19 00
15	....	Gustav Bostert, Johnstown, Pa., ...	18 00
108	....	Trenton Milling Co., Morrisville, ...	17 00
114	....	Morris Briggs, Woodbury, Pa., ...	18 00
223	(In Ohio), ...	C. Beckert, Allegheny, Pa..	18 00

Percentage Composition of Brans.

Number.	Moisture.	Protein.	Fat.	Remarks.
Winter Brans.				
277, ...	9.13	15.56	3.92	
201, ...	9.11	15.31	4.04	
33, ...	9.89	14.13	4.34	Crude fiber, 8.85 per cent.
211, ...	10.44	16.50	4.04	
27, ...	9.46	14.44	4.94	Crude fiber, 11.16 per cent
Range, ...	9.11-10.44	14.13-16.50	3.92-4.94	
Average, ...	**9.43**	**15.19**	**4.26**	
Spring Brans.	9.57	14.44	5.08	Crude fiber, 11.88 per cent
179, ...				
222, ...	9.04	15.19	5.03	
262, ...	9.63	15.56	4.86	
278, ...	9.08	15.44	4.88	
281, ...	10.35	14.44	4.04	Crude fiber, 9.29 per cent
134, ...	9.33	14.31	4.49	Crude fiber, 11.88 per cent.
119, ...	10.18	15.00	4.32	Crude fiber, 10.00 per cent.
266, ...	9.86	14.31	4.51	Crude fiber, 12.12 per cent.
268, ...	9.27	14.88	4.63	Crude fiber, 12.62 per cent
Range, ...	9.04-10.35	14.31-15.44	4.04-5.08	
Average, ...	**9.65**	**14.84**	**4.63**	
Brans not Classified				
105, †	10.59	16.94	4.89	
176, *	9.47	16.00	4.25	
255, *	9.80	15.06	4.38	Marked "coarse."
171, *	9.89	15.56	4.66	
187, *	10.66	14.06	3.73	Crude fiber, 7.90 per cent
248, *	10.04	15.31	3.82	Marked "coarse."
66, *	9.72	15.94	3.92	
71, *	9.35	15.81	4.69	
60, *	10.56	16.31	3.71	
244, *	9.63	15.63	4.65	Marked "coarse."
199, *	10.13	15.31	4.43	
159, *	9.41	14.88	4.02	
2, †	10.68	11.94	4.42	Fiber, 9.50 per cent.
221, *	10.29	16.69	4.86	
104, †	10.34	15.94	4.78	

Number.	Moisture.	Protein.	Fat.	Remarks.
11, *	10.38	16.06	4.26	
56, *	10.47	14.06	4.36	
218, *	10.54	15.88	4.09	
6, †	9.83	15.38	5.02	
8,	9.89	11.31	4.66	
15, †	9.23	14.88	4.79	Fiber, 10.82 per cent.
108,	8.66	16.19	5.02	
114,	8.76	15.25	4.57	
223, *	10.01	15.06	4.30	
251,	9.75	15.69	4.86	
Range,	8.66-10.68	14.06-16.94	3.71-5.02	
Average,	10.02	15.49	4.45	
Range of all samples designated or supposed from location of mill to be winter wheat,	9.11-10.54	14.06-16.69	3.71-4.94	
Average,	9.88	15.40	4.26	
Range, spring wheat,	9.04-10.68	14.31-16.94	4.04-5.08	
Average,	9.82	15.12	4.70	
Range for all brans analyzed,	8.66-10.68	14.06-16.94	3.71-5.08	
Average,	**9.54**	**15.30**	**4.48**	

* Supposed from location of manufacture to be derived from winter wheat.
† Supposed from place of manufacture to be derived from spring wheat.

A microscopic examination of the foregoing samples revealed little of special interest except in a few cases:

No. 27 was quite dirty; a small quantity of oat hulls and the black hulls of a weed seed (*Polygonum dumetorum var. scandens*) in considerable quantity. This weed is related to buckwheat and its hulls, while of probably very slight food value, are not known to be directly injurious to animals.

No. 222 contains somewhat more oat hulls, but fewer weed seeds. The latter are chiefly *Polygonum.*

No. 262 shows rather more oat hulls; the amount is, however, probably under 5 per cent.

No. 8 contains some straw, though in small proportion.

These results indicate that the process of winnowing is not thoroughly carried out in all mills and that, in some mills, either very impure wheat is ground or oat hulls are added to the contents of the bran bin. In none of the above cases is the amount of impurity present such as to indicate a deliberate attempt to substitute other cheaper substances for bran; but lack of care for the purity of this feeding stuff is indicated.

Compared with the brans sold recently in neighboring States, the Pennsylvania samples make the following showing:

Comparison of Brans from Different States.

	Number of analyses.	Protein, per cent. Highest.	Protein, per cent. Lowest.	Protein, per cent. Average.	Fat, per cent. Highest.	Fat, per cent. Lowest.	Fat, per cent. Average.
Winter Wheat:							
Pennsylvania,	5	16.50	14.13	15.19	4.94	3.92	4.26
New England States, 1898-9,	45	17.8	13.6	15.5	5.6	3.5	4.4
Spring Wheat:							
Pennsylvania,	9	15.44	14.31	14.84	5.08	4.04	4.63
New England, 1898-9,	53	17.5	15.1	16.1	5.6	4.4	4.9
All Varieties:							
Pennsylvania,	38	16.94	14.06	15.30	5.08	3.71	4.48
New England, 1898-9,	120	17.9	13.6	15.8	5.6	3.5	4.7
New York, 1898-9,	12	17.13	13.37	15.36	5.64	3.40	4.79

In general, the range of composition found in the Pennsylvania samples is not greater than was found to occur in New York during the first year of the operation of the food control law enacted by the latter State; but the brans sold in New England, where examinations of the cattle foods have been made for a longer period, show a quite distinct superiority in average composition.

Determinations of fiber were made in a number of instances where the proportion of protein fell below 14.5 per cent. The percentages of this constituent found in such cases vary from 7.90 to 12.62, quantities very similar to those obtained by Connecticut* in recent bran analyses.

The number of brans that were distinctly indicated to be spring and winter wheat brans respectively, is too small to afford a basis for comparison. A larger number of analyses reported sometime since by the Pennsylvania State College Agricultural Experiment Station,† exhibit a superiority in protein content for average spring bran exceeding that shown by the New England averages above indicated.

*B. 130, pp. 22-5.

† Bulletin 48, December, 1899.

Wheat Middlings.

There were selected by Department agents 38 samples of wheat middlings, exclusive of those designated as "ship stuff" and "red dog flour." The kind of wheat from which they were derived was specifically stated only in case of three samples from winter wheat. The samples selected were as follows:

No.	Manufacturer.	Dealer.	Price per ton.
164	Dwight M. Baldwin, Minneapolis, Minn.,	....	$21 00
196	Bare Milling Co., Roaring Spring, Pa.,	Bare Milling Co., Roaring Springs, Pa.,	....
241	Bliss & Merrick, Corry, Pa.,	Bliss & Merrick, Corry, Pa.,	18 00
73	Champion Milling Co., Brownsville, Pa.,	L. C. Waggoner, Brownsville, Pa.,	20 00
166	Clapper Bros., Martinsburg, Pa.,	....	20 00
193	Clapper Bros., Martinsburg, Pa.,	Clapper Bros., Martinsburg,	18 00
284	C. F. Dyer, Millersburg, Pa.,	S. T. Slight,	20 00
226	Elkhart Swan Milling Co., Chicago, Ill.,	Wm. Fisher, Allegheny, Pa.,	17 00
126	Empire Grain and Elevator Co., Binghamton, N. Y.	Snyder Bros., Dalton, Pa.,	18 00
233	C. A. Foster, Carnegie, Pa.,	McClelland & Siple, Pittsburg, Pa.,	20 00
2[illegible]5	Full Frank Grain Co., Milwaukee, Wis.,	Cyrus R[illegible], [illegible], Pa.,	1[illegible]
69	Gaddis & Co., Uniontown, Pa.,	M. H. Clark, Uniontown, Pa.,	20 00
61	David Hartz, Morgantown,	David Hartz, Morgantown,	19 00
220	Hunter Bros., St. Louis, Mo.,	Chas. Friel, Pittsburg, Pa.,	22 00
228	Hunter Bros., St. Louis, Mo.,	C. Kellner, Allegheny,	19 00
230	Hunter Bros., St. Louis, Mo.,	Byrne & Steele, Pittsburg,	20 00
14	McDermott, Wertz & Co., Johnstown, Pa.,	McDermott, Wertz & Co., Johnstown, Pa.,	20 00
154	F. & I. Mentzer, Frankstown, Pa.,	....	19 [illegible]
31	Milton Floury, Walters, Pa.,	C. W. Walter, Walters, Pa.,	20 00
1	Northwestern Co., Minneapolis, Minn.,	John Reside, Chambersburg,	18 00
215	Northwestern Elevator Co., Toledo, O.,	D. Whitmeyer, Allegheny, Pa.,	18 50
24	Pillsbury Milling Co., Minneapolis, Minn.,	J. C. Widman Shuler, Johnstown, Pa.,	18 00
216	Pittsburg Milling Co., Pittsburg, Pa.,	Branthoover Bros., Pittsburg, Pa.,	22 00
213	Pittsburg Milling Co., Pittsburg, Pa.,	Brown & Co., Pittsburg, Pa.,	22 00
45	Seaboard Milling Co., Reading, Pa.,	A. N. Kissinger & Son, Reading, Pa.,	20 00
51	Shaffer, Wanner & Co., Fleetwood, Pa.,	M. C. Dietrich, Kempton, Pa.,	21 00
46	Steelton Flour Mills Co., Steelton, Pa.,	A. N. Kissinger & Son, Reading, Pa.,	22 00
165	The George Tileston Milling Co., St. Cloud, Minn.	C. L. Hoof, Altoona, Pa.,	15 00
109	Trenton Milling Co., Trenton, N. J.,	Trenton Milling Co., Morrisville, Pa.,	17 00
7	Truesdale & Speer, Minneapolis, Minn.,	Coyle & Diehl, Chambersburg, Pa.,	17 00
79	Warren Mills Co., Warren, Pa.,	Warren Mills Co., Warren, Pa.,	18 00
203	Warwick & Justice, Massilon, Ohio,	Peter Bock, Pittsburg, Pa.,	20 00
1[illegible]	Weston Mill Co., Scranton, Pa.,	Weston Mill Co., Scranton, Pa.,	20 [illegible]
103	E. S. Woodworth & Co., Minneapolis., Minn.	W. K. Heebner, West Point, Pa.,	19 00
18	....	Gustav Bostert, Johnstown, Pa.,	19 00
20	....	John Thomas & Co., Johnstown, Pa.,	18 00
75	(Cleveland, O.),	P. Davis, Sugar Grove, Pa.,	22 00
227	(In Ohio),	C. Beckert, Allegheny, Pa.,	19 00
260	....	Joseph Burkholder, Hummelstown, Pa.,	19 00

Percentage Composition of Wheat Middlings.

No.	Description.	Moisture.	Protein.	Fat.	Remarks.
[illegible]	Middlings,	10.58	17.44	5.31	
[illegible]	Pure middlings,	11.31	12.94	2.81	Ash, 2.02 per cent.; fiber, 2.08 per cent.
241	Middlings,	9.75	14.31	3.72	Ash, 4.86 per cent.; fiber, 7.03 per cent.
73	Middlings,	10.90	13.88	3.20	Ash, 2.79 per cent.; fiber, 2.33 per cent.
166†	Middlings,	9.87	14.56	4.18	Ash, 3.49 per cent.; fiber, 4.26 per cent.
195†	Finished middlings,	10.05	15.75	4.18	
284*	Middlings,	10.08	17.94	5.58	
226	Brown middlings,	10.32	16.25	5.41	
126	Brown middlings,	9.61	14.81	5.10	
233	Wheat middlings, No. 2 white,	9.61	17.81	5.63	
265‡	Western red middlings,	9.76	18 50	4.81	
69	Middlings,	10.50	15.06	3.43	
61†	White middlings,	12.10	13.13	1.85	
220	Middlings, No. 2 white,	9.93	14.88	3.57	Ash, 1.09 per cent.; fiber, 1.08 per cent.
228	Middlings, No. 2 fancy,	9.50	16.76	4.94	
230	Middlings, brown,	9.95	16.25	4.84	
14	Wheat middlings,	10.23	16.94	4.30	
154	Middlings,	10.21	16.13	4.40	
34†	Wheat middlings,	11.33	13.94	3.62	
1‡	Middlings;	10.08	16.88	5.27	Ash, 2.21 per cent.; fiber, 2.10 per cent.
215	Middlings, No. 2,	10.13	15.75	3.98	
24†	Brown middlings,	9.57	16.69	4.94	
216*	Winter wheat middlings,	10.28	15.88	4.24	
213	Middlings, No. 2,	10.29	17.13	4.53	
45	Red middlings,	10.81	16.69	5.38	
51†	Red middlings,	11.58	14.44	3.91	
46†	White middlings,	10.98	17.13	4.66	Ash, 2.479 per cent.; fiber, 2.63 per cent.
165‡	Red middlings,	9.99	17.19	5.30	
109	Middlings,	9.03	16.69	5.97	
7‡	Middlings,	9.24	16.38	5.89	
79	Wheat middlings,	11.43	14.75	4.46	
203*	Winter wheat middlings,	9.89	14.63	3.77	
126*	Wheat middlings,	9.16	17.50	6.26	Ash, 4.03 per cent.; fiber, 5.49 per cent.
103‡	Wheat middlings,	11.19	17.81	5.45	
18	No. 2 middlings,	9.64	17.06	4.63	
20	Brown middlings,	9.63	18.38	5.61	

75	"B" middlings,	10.59	16.75	5.86	
227	Brown middlings,	10.42	15.75	4.31	Ash, 3.75 per cent.; fiber, 4.93 per cent.
260‡	Western middlings,	10.42	14.63	4.04	
	Range of composition of all samples,	9.24-12.10	12.94-18.50	1.85-6.26	
	Average composition,	**10.26**	**16.05**	**4.60**	
	Range of composition of samples (* & †) designated or judged by location to be from winter wheat (10 samples),	9.87-12.10	12.94-17.94	1.85-5.58	
	Average,	10.74	15.04	4.63	
	Range of composition of samples (‡) judged by location to be from spring wheat (10 samples),	9.24-11.19	14.63-18.50	3.98-5.89	
	Average,	**10.11**	**16.81**	**5.00**	

* Designated as from winter wheat. †Judged by location to be from winter wheat.

‡ Judged by location to be from spring wheat.

These samples compare with those analyzed, 1898-9, in New England and New York, as follows:

	Number of analyses.	Protein, per cent. Highest.	Protein, per cent. Lowest.	Protein, per cent. Average.	Fat, per cent. Highest.	Fat, per cent. Lowest.	Fat, per cent. Average.
Pennsylvania,	39	18.50	12.94	16.05	6.26	1.85	4.60
New England,	135	22.2	12.4	17.0	7.1	2.6	5.0
New York,	14	20.06	14.81	17.76	8.51	3.90	5.53

In this case also, while the range of composition is not exceptionally wide, the average percentages of the more valuable materials are distinctly below those exhibited in States subject to a cattle-food control.

In nine samples whose protein was less than 14.75 per cent., determinations of fiber and ash were made with results ranging from 7.03 to 1.08 per cent. for fiber, and 4.86 to 1.90 per cent. for ash. Twenty-three samples analyzed in Connecticut in 1899, showed fiber, 10.31 to 1.05 per cent., and ash, 5.52 to 2.86 per cent., and fourteen samples analyzed in New York, the same year, showed fiber, 10.35 to 2.17 per cent., and ash, 5.10 to 2.52 per cent. Clearly, the low protein in the Pennsylvania samples is not attributable to excessive quantities of these two elements introduced by conspicuous additions of foreign matters. These analyses would not show the addition to a pure middlings of large quantities of the fluffy dust from the dust room, in which the hairs from the tip of the grain are deposited as a result of the modern milling processes.

The name attached to the brand gives no certain indication of feeding value. This is well exhibited by the range of protein content found in those specimens to which some particular grade name was given.

"Pure," "white," "finished,"	17.13 to 12.94 per cent.
"No. 2 white,'	17.81 to 14.88 per cent.
"Red,"	18.50 to 14.44 per cent.
"Brown,"	18.38 to 14.81 per cent.

The "white" middlings contain, of course, more starch than the "brown" middlings, bran being more abundant in the latter.

Microscopic examination with a low-power lens discovers no conspicuous foreign material except in case of No. 75, which is rendered quite impure by the presence of numerous weed seeds.

Wheat Shorts.

The "shorts," as previously explained, are chiefly composed of the same tissues of the wheat grain as those from which the bran is derived.

Three samples were taken bearing this specific name:

No.	Manufacturer.	Dealer.	Price per ton.
58	David Hartz, Morgantown, Pa.,	David Hartz, Morgantown, Pa.,	$19 00
253	——, Middletown, Pa.,	S. B. Vance, Middletown, Pa.,	19 00
261	——, Minneapolis, Minn.,	J. B. Deckard, Middletown, Pa.,	20 00

The composition of these samples was found to be as follows (per cent.):

Number.	Moisture.	Protein.	Fat.
58,	9.88	18.31	5.97
253,	10.32	16.00	4.84
261,	9.59	15.25	4.72
Average,	**9.93**	**16.52**	**5.18**

Jenkins and Winton's compilation of American analyses made prior to 1892 shows the following figures (per cent.):

	Moisture.	Protein.	Fat.
Highest,	15.5	19.4	6.1
Lowest,	4.1	11.1	2.5
Average,	11.8	14.9	4.5

The Pennsylvania samples, while some are much richer in protein and fat than others, are well above the averages given by Jenkins and Winton.

Microscopic examination failed to show any adulteration.

Ship Stuff.

Of this variety of middlings, but one sample was examined:

No.	Manufacturer.	Dealer.	Price per ton.
269	....	J. B. Deckard, Middletown, Pa.,	$20 00

Its percentage composition was as follows:

	Moisture.	Protein.	Fat.
Composition,	10.53	16.13	3.88

Red Dog Flour.

This low grade flour is often included with the middlings. Four samples were submitted for analysis:

No.	Manufacturer.	Dealer.	Price per ton.
180	Dwight M. Baldwin, Graceville, Minn.,	Geo. P. Wilt, Duncansville, Pa.,	$18 75
276	Pillsbury Co., Minneapolis, Minn.,	Cyrus Romberger, Lykens, Pa.,	19 00
273	G. D. Stevens, Minneapolis, Minn.,	A. M. Pike, Halifax, Pa.,	20 00
17		Gustave Bostert, Johnstown, Pa.,	20 00

The results of analysis were as follows (per cent.):

No.	Description.	Moisture.	Protein.	Fat.
180	Red dog middlings,	10.16	17.94	5.28
276	Pillsbury red dog middlings,	9.54	20.25	5.77
273	Red dog flour,	10.16	19.13	4.72
17	"Daisy red dog,"	9.72	19.25	3.70
	Range of composition,	9.54-10.16	17.94-20.25	3.70-5.77
	Average,	**9.90**	**19.14**	**4.87**

The microscope reveals no foreign matters in these samples. This product is seen to contain considerably more protein than either of the wheat products already described.

Wheat Feeds.

Instead of selling the various products of the mill, other than flour, separately under their distinctive names as bran, middlings, etc., many millers combine several or all of these by-products and sell them under the name of "wheat feed." It is clear that quite a wide range of composition might be expected in a feeding-stuff of such varying method of preparation. Only three samples bearing this name were submitted by the Department agents. They were:

No	Manufacturer.	Dealer.	Price per ton.
146	Empire Grain and Elevator Co., Binghamton, N. Y.	Snyder Bros., Dalton, Pa., ...	$19 00
136	C. H. Sears, Clark's Summit, Pa., ...	C. H. Sears, Clark's Summit, ...	19 00
9	(Akron, O.), ...	J. L. Hockensmith, ...	20 00

The results of analysis were as follows per cent.):

No.	Description.	Moisture	Protein.	Fat.	Fibre.
146	Spring wheat bran and middlings, ...	9.78	15.94	4.49	....
136	Wheat feed, bran and shorts, ...	9.20	10.19	2.69	19.81
9	Buckeye wheat feed, ...	10.08	16.50	4.53	....
	Range of composition, ...	9.20-10.08	10.19-16.50	2.69-4.53	....
	Average, ...	**9.69**	**14.21**	**3.90**	....

On examination under the microscope, the following facts appear:

No. 146. Bran is the chief constituent. The fine material contains many of the hairs which, in the best mills, go to the dust room. Some whole oats and oat hulls are present, but these form a very small percentage of the entire feed.

No. 136. While the bulk is chiefly composed of bran, the sample contains a large amount of fibrous material, finely divided and closely resembling, under a power of 50 diameters, the compact, fibrous structure and yellowish tint of corn cob. Some oat hulls were also present.

No. 9. Chief bulk composed of bran; the amount of middlings present is small; there is present a large amount of the hair from the tip of the grain, indicating a probable admixture of the dust room contents. A little oat hull appears, but is not conspicuous.

Only one of these brands has been analyzed in other States, viz: "Buckeye wheat feed." The composition shown by these analyses is as follows:

	Protein, per cent.	Fat, per cent
Connecticut (3 samples), ...	17.75-16.37	4.41-4.37
New York (1 sample), ...	15.38	5.12

The Pennsylvania sample is up to the average for the brand.

Wheat feeds, in general, as shown by 219 analyses of market feeds made in New England States, have the following range of composition:

	Protein, per cent.	Fat, per cent.
Highest,	20.0	5.8
Lowest,	14.0	3.6
Average,	16.6	4.7

The fiber in 48 samples recently analyzed in Connecticut, ranges from 5.20 to 9.41 per cent.

No. 136 shows a content of protein and fat far inferior to the minimum shown by the New England analyses for goods of this class. The material was therefore examined for fiber and found to contain fully twice as much as the maximum observed in such goods. A mixture of equal parts of average wheat feed and fine ground corn cob would contain, protein, 9.5 per cent.; fat, 2.6 per cent.; fiber, 18.5 per cent. These figures quite nearly approximate those found for No. 136.

Wheat Flour.

While not strictly coming within the list of cattle-foods, a sample of "Pillsbury's Best" wheat flour, manufactured by the Pillsbury & Washburn Co., of Minneapolis, Minn., and sold by Snyder Bros., Dalton, Pa., at $4.60 per barrel, was submitted for analysis. Examined by the methods adopted in the preceding cases, it gave the following results:

No. 121. Moisture, 11.65; protein, 11.69; fat, .60.

RYE PRODUCTS.

Rye in both botanical and general chemical characters closely resembles wheat. When subjected to milling, it is separated into a series of products similar to those which wheat produces.

The composition of the entire grain is represented by analyses of 57 samples from various portions of the United States reported by Richardson:*

	Average, per cent.	Highest, per cent.	Lowest, per cent.
Moisture,	8.67	10.00	7.00
Ash,	2.09	3.72	1.31
Protein,	11.32	15.53	8.75
Fiber,	1.46	1.90	1.10
Nitrogen-free extract,	74.52	77.54	68.74
Fat,	1.94	2.91	1.38

* Op. cit., Bull. 9, p. 67.

So that, in general, rye contains less protein and fiber and more starch than wheat. On account of both its nutritive value and dietetic effects, it and its products are particularly prized for feeding horses. Lavalard,* after numerous experiments with cab horses and those in the cavalry and artillery services of the French army, found the effects more variable than those of other grains and believes this is due to variability of composition.

The following samples of rye products were submitted:

No.	Manufacturer.	Dealer.	Price per ton
	Rye Chop.		
40	John D. Bieber, Oley, Pa.,	A. N. Kissinger & Son, Reading, Pa.,	$25 00
195	C. E. Lingafelt, Hollidaysburg, Pa.,	C. E. Lingafelt,	25 00
12	McDermott, Wertz & Co., Johnstown, Pa.,	McDermott, Wertz & Co., Johnstown,	28 00
	Bolted Rye Chop.		
270	Levi Brant, Harrisburg, Pa.,	....	25 00
	Rye Middlings.		
29	Mann & Allshouse, Easton, Pa.,	Mann & Allshouse, Easton, Pa.,	18 00

The percentage composition of these feeding stuffs was as follows:

No.	Description.	Moisture.	Protein.	Fat.	Remarks.
40	Rye chop,	11.49	9.63	2.19	
195	Rye chop,	10.32	11.25	2.09	
12	Rye chop,	11.68	10.00	1.03	Coarse.
	Range of composition,	10.32-11.68	9.63-11.25	1.03-2.19	
	Average composition,	**11.16**	**10.29**	**1.77**	
270	Bolted rye chop,	10.02	10.75	1.66	
29	Rye middlings,	9.63	13.66	3.36	

The microscope does not indicate any adulteration in these samples.

In composition, the chops fall well within the range of composition for whole grain given above, except the percentage of fat in No. 12, which is below the minimum there given. The composition of the middlings is normal; they are seen to have considerably less protein and fat than average wheat middlings.

BARLEY AND ITS BY-PRODUCTS.

Barley, though grown in America especially for malting purposes, is used in many countries as a horse feed, in place of oats. Lavalard† mentions such substitution as general in Italy, Spain and Algeria, where oats cannot be profitably raised.

* Experiment Station Record, **12**, 16.
† *Ib.*, 14

Experiments made by the *Compagnie generale des omnibus* of Paris, with both draught and saddle horses during twenty years, show that while barley can replace oats in horse rations, a somewhat larger quantity must be employed; also that barley bran is very tough, with a tendency in inferior varieties to seriously lower the amount of digestible matter.

A study by Richardson* of sixty samples of barley grown in different parts of the United States gave the following results:

	Average.	Highest.	Lowest.
Composition (per cent.), whole grain:			
Water,	6.53	9.15	4.53
Ash,	2.89	4.43	1.50
Protein,	11.33	14.88	8.75
Fiber,	3.80	4.65	2.64
Nitrogen-free extract,	72.77	76.79	68.99
Fat,	2.68	3.54	2.06
	100.00		
Percentage of hull,	15.22	16.94	12.55
Weight per bushel (pounds),	54.0	67.9	48.5

No samples of this grain have been submitted for analysis; it enters, however, into the composition of a number of mixed feeds elsewhere discussed.

As remarked above, barley is grown in America chiefly for malting purposes. When the grain is moistened and kept at a certain temperature it germinates, the ferments it contains become active and convert the starch into maltose and finally into glucose, which is capable of solution in water and of alcoholic fermentation by yeast. The germinated barley is dried, freed from its sprout, which is injurious to the malted liquor, and is then known as "malt," which, either alone or together with other starchy materials whose solution it promotes, is used in the manufacture of malted liquors. A very large proportion of the protein and fat, together with some valuable carbohydrates remain in the spent malt or grains, so that these become, in turn, valuable as cattle-feeds; for this purpose they are either used in a fresh, moist state or in a kiln-dried condition.

According to Stein,† 100 parts of barley yield 92 of malt and 2.5 of sprouts, as follows:

Composition.	Barley.	Malt.	Sprouts.
Ash,	2.42	2.11	0.29
Protein,	12.28	10.98	0.77
Fiber,	19.86	18.76	0.89
Nitrogen-free extract,	61.88	58.06	0.47
Fat,	3.56	2.09	0.08
	100.00	92.00	2.50

* Bulletin 9, Chemical Division, U. S. Dept. Agric., pp. 58-78.

† Wilde's Centrbl. 1860, 2, S-23: Johnson, How Crops Grow, p. 159.

A loss of 6.5 parts occurs as the result of the life processes active during the malting.

No samples of "brewers' grains" have been submitted for examination at this time, but the following averages given by Jenkins and Winton* will suffice to give a general idea of their composition.

	Wet grains (15 analyses).			Dry grains (3 analyses).		
	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.
Water,	75.7	79.4	68.6	8.2	11.9	6.2
Ash,	1.0	1.5	0.3	3.6	3.8	3.3
Protein,	5.4	6.9	4.3	19.9	20.3	19.3
Fiber,	3.8	5.6	3.1	11.0	11.6	10.2
Nitrogen-free extract,	12.5	15.9	9.6	51.7	56.8	46.1
Fat,	1.6	2.9	0.8	5.6	6.5	4.2
	100.0	....	....	100.0	....	....

Analyses of a related substance, "dried distiller's waste," made in this laboratory by C. A. Browne, Jr., and C. P. Beistle, Assistant Chemists† show that the nitrogen-free extract of the spent grains instead of being composed, as in the original malt, of starch and sugars chiefly, contains very little of these valuable nutrients, and is made up principally of pentosans of less certain feeding value.

Malt Sprouts.

Samples of malt sprouts have been received as follows:

No.	Manufacturer.	Dealer.	Price per ton.
113	(Bought in Philadelphia).	M. A. Kirby,	$17 50
117		Trenton Milling Co., Morrisville,	18 00
256		Sims Co.,	13 50

Their percentage composition is:

Number.	Moisture.	Protein.	Fat.
113,	9.49	24.00	1.78
117,	10.42	21.69	1.54
256,	12.95	23.19	1.50
Range,	9.49-12.95	21.69-24.00	1.50-1.78
Average,	**10.95**	**22.96**	**1.61**

*Op. cit., p. 18.

† Journal American Chemical Society, April, 1901.

Some grains of malt were present in each case, as would be expected from the conditions of manufacture.

The composition agrees very well with Jenkins and Winton's average:

	Per cent.
Moisture,	10.2
Ash,	5.7
Protein,	23.2
Fiber,	10.7
Nitrogen-free extract,	48.5
Fat,	1.7
	100.00

The difference in price between Nos. 113 and 117, taken in southeastern Pennsylvania, and No. 256, taken in the northwestern corner of the State, is rather striking.

The value of this food as a low-priced balancing material is apparent.

OATS AND OAT PRODUCTS.

Owing to their composition and palatability to domestic animals, oats enter into a great variety of combinations with other grains in the preparation of a great variety of mixed feeds. Less extensively used than wheat and corn for the manufacture of breakfast foods, the various oat-meal preparations for human consumption leave, nevertheless, a large volume of residual material, chiefly oat hulls, for use in the manufacture of cattle foods. Because of the extensive use of oat hulls for this purpose, it is important to secure a clear knowledge of their composition and digestilibity relative to that of the whole grain.

Considering first the proportion of hull (consisting of the pallets and sometimes the glumes) to the entire grain:

The writer, working under the direction of Mr. Clifford Richardson,* determined this proportion for 166 samples of oats sent from all sections of the United States; the average was 30.03 per cent. of the entire grain. For the compact white, black and mixed oats of the north, weighing 38 pounds per struck bushel, the proportion was 29.3 per cent.; for the fluffy, red rust-proof oats of the south, weighing 34.5 pounds per bushel, the proportion was 30.92 per cent. The extreme range in percentage of hull was 20.72 to 44.63 per cent., the grain in the latter case being evidently immature.

* Bulletin No. 9, Division of Chemistry, U. S. Department of Agriculture.

The Ohio Experiment Station from the examination of 69 varieties of oats, found a range in the percentage of hulls, of 21.6 to 35.2 per cent., average 30 per cent.

In the cleaned grain before milling the proportion of kernel is therefore 70 pounds per hundred; but, owing to the breakage of the kernel in milling, the yield of kernel is slightly reduced, being 67 pounds per hundred, on the average.

Under Richardson's directions, 179 samples of oats and 100 samples of oat hulls were analyzed, with the following percentage results:

	Kernel.	Hull.	Entire oats corresponding.
Moisture,	6.93	5.22	6.42
Ash,	2.15	5.59	3.18
Protein,	14.31	2.48	10.76
Fiber,	1.38	17.[illegible]	6.33
Nitrogen-free extract,	67.09	68.03	67.37
Fat,	8.14	.89	5.94
	100.00	100.00	100.00

While the kernels themselves are richer in protein than those of any other cereal, the adherent hull makes them, as fed, little richer than corn. However, the low digestibility of the fiber of the entire oat so reduces the proportion of digestible carbohydrates as to give to this feeding stuff a relatively high nutritive ratio. The hulls, considered alone, while they contain as much nitrogen-free extract as the kernel, really contain it less in the form of sugar and starch than in that of the less valuable pentosans, while the high fiber, low fat and low protein all tend to rank the hull with corn cob and straw in nutritive value.

The analyses reported by Richardson do not afford a convenient statement of the variations in the composition of American oats. For this, 30 analyses compiled by Jenkins and Winton may be used:

	Highest, per cent.	Lowest, per cent.	Average, per cent.
Moisture,	13.5	8.9	11.0
Ash,	3.6	2.0	3.0
Protein,	14.4	8.0	11.8
Fiber,	12.9	1.5	9.5
Nitrogen-free extract,	66.9	53.5	59.7
Fat,	6.8	3.4	5.0
	....	....	100.0

Despite the wide range of difference in the whole oats, the composition of the kernel is less affected by climatic conditions than is that of most other cereals, the proportion of husk to kernel being a more influential factor, and the compactness of the grain the best method of judging of its bushel value.

Ground Oats.

Only one sample of ground oats was submitted, viz: No. 123, manufactured and sold by the Weston Mill Co., of Scranton, Pa., at $25.00 per ton. Its composition was as follows:

	Per cent.
Moisture,	8.99
Protein,	9.25
Fat,	3.90

Therefore, while much below the average in the amounts present of its more valuable components, it comes safely within the range of variation for this grain.

Oat Feeds.

From the name, it might be anticipated that these feeding stuffs would differ little from ground oats. In fact, however, they are in many cases composed chiefly of the oat hulls left as a waste from oat meal manufacture. For this reason, a careful study of their composition is important.

Samples were submitted as follows:

No.	Manufacturer.	Dealer.	Price per ton.
3	Akron Cereal Co., Akron O.,	L. A. Read, Chambersburg, Pa.,	$16 00
102	Akron Cereal Co., Akron, O.,	W. K. Heebner, West Point, Pa.,	15 00
4	American Cereal Co., Akron, O.,	Coyle & Diehl, Chambersburg, Pa.,	17 00
5	Andrew Cullin Co., New York,	Coyle & Diehl, Chambersburg, Pa.,	16 00
183	Andrew Cullin Co., New York,	Geo. P. Wilt, Duncansville,	15 50
197	Andrew Cullin Co., New York,	Geo. P. Wilt, Duncansville,	14 00

Their analyses are as follows:

No.	Description.	Moisture.	Protein.	Fat.
3	Royal oat feed,	7.07	5.88	2.48
102	Royal oat feed,	8.27	6.19	2.50
4	Oat feed,	7.40	11.06	2.99
5	Oat feed,	7.28	7.81	3.67
183	Crescent oat feed,	7.46	6.69	3.04
197	Crescent oat feed,	7.15	6.75	3.45
	Range,	7.07-8.27	5.88-11.06	2.48-3.67
	Average,	**7.44**	**7.40**	**3.02**

These analyses distinctly show that, with the exception of No. 4, the feeds are largely composed of something other than the oat kernel. Assuming that the oats and hulls are of average composition, the analyses indicate that, with the exception named, the feeds contain at least one-half their weight of added oat hulls.

The condition of the hulls in the several samples is quite different, being coarse in some cases, fine in others. The Royal Oat Feed samples contain 38 to 48 per cent. of coarse hull, while the amount in Nos. 4 and 5 was less than 3 per cent.

No guaranties accompanied the lots from which these samples were drawn. In New York State, the Crescent Oat Feed is licensed with a guaranty of 11.0 per cent. of protein and 7.35 per cent. of fat, but a sample reported in September, 1900 (Bulletin No. 176, pp. 28-9, New York Exp. Station), showed only 7.8 per cent. protein and 3.5 per cent. fat, while three samples analyzed in New England between May, 1898, and January 1, 1900, contained an average of 7.9 protein and 3.3 per cent. fat. The quality of the goods sold in Pennsylvania not only falls below that guaranteed in New York, but also is materially inferior to that exhibited by the samples analyzed in New York and New England.

The Royal Oat Feed was guaranteed in New York State to have 8.25 per cent. protein and 4.14 per cent. fat; but a single analysis made there in 1900, showed only 5.1 per cent. protein and 2.5 per cent. fat.

While the variations in composition to which both the entire oat and the oat hulls are subject, make impossible any exact computation of the precise proportion in which they are combined to form a given mixture from its composition, the following statements based upon the average composition of the respective ingredients may be helpful:

	Protein, per cent.	Fat, per cent.
Equal parts of oats and oat hulls,	6.63	3.40
One-third oats, two-thirds hulls,	4.92	2.53

In this connection should be mentioned two feeds which are sold under names that are not descriptive:

No.	Manufacturer.	Dealer.	Price per ton.
91	Muscatine Oat Meal Co., Muscatine, Iowa,	J. Watson Craft, Ambler, Pa.,	$16 00
263	American Cereal Co., Chicago, Ill.,	J. B. Deckard, Middletown, Pa.,	16 00

Their analyses are (per cent.):

No.	Description.	Moisture.	Protein.	Fat.
91	Friends' consolidated dairy food,	8.58	6.31	3.08
263	Cereal feed,	7.23	4.06	1.55

The analyses immediately reveal the inferior character of these feeds.

Microscopic examination shows these two feeds to be chiefly composed of oat hulls, hair and dust, with more of the dust in the former of the two foods.

In general, the nutritive value of such feeds is little greater than that of corn stover. The term "concentrated foods" is not properly applied to them.

CORN.

From the fact that corn is the leading grain grown for cattle feeding and that, more than any other cereal, it is subjected to a great variety of manufacturing processes for the production of starch, glucose and a great variety of other articles of human consumption, especial interest attaches to its composition.

The percentage composition of the two great groups of varieties, the dent and the flint, is well represented by the figures for American analyses compiled by Jenkins and Winton:*

Percentage Composition of Corn.

	Dent (86 analyses).			Flint (68 analyses).		
	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.
Moisture,	10.6	19.4	6.2	11.3	19.6	4.5
Ash,	1.5	2.6	1.0	1.4	1.9	1.0
Protein,	10.3	12.8	7.5	10.5	13.7	7.0
Crude fiber,	2.2	4.8	0.9	1.7	2.9	0.7
Nitrogen-free extract,	70.4	75.7	65.4	70.1	76.7	65.0
Fat,	5.0	7.5	3.1	5 0	7.1	3.4
	100.0	....	....	100.0	....	....

There is therefore little difference in the general composition of these two types of corn, notwithstanding their unlike appearance in form and usually in color. The greatest difference observed is in

*Bulletin 11, Office of Experiment Station, U. S. Dept. of Agriculture.

the smaller amount of fiber in the flint corn and in its wider range of composition as respects protein and nitrogen-free extract, and less range in fiber and ash.

Considering the range of variation, it is apparent that while the highest figure for nitrogen-free extract is but one-sixth greater than the lowest, the highest percentages of protein and fat are about twice as great as the lowest percentages; in the less important constituents, fiber and ash, the range of variation is even greater.

The kernel of the corn exhibits a subdivision into parts distinctly seen by the naked eye. Voorhees* has studied the composition of these several parts, which he describes somewhat as follows:

"a. The husk or skin, which covers the whole kernel; it consists of two distinct layers, the outer and inner, which when removed constitute the bran, and contain practically all the crude fiber of the whole grain.

b. "A layer of gluten cells, which lies immediately underneath the husk; it is yellow in color, and cannot be readily separated from the remainder of the kernel.

"c. The germ, readily distinguishable by its position and form; it also contains gluten, though it is particularly rich in oil and mineral constituents.

"d. The starchy portion of the grain, which is divisible into two sub-portions—a yellow, flinty part lying on the sides of the grain and made up of very compact cells and a lighter colored portion in which the cells are less compact; in both portions, however, starch is the principal material in the cells.

A somewhat imperfect separation of 100 kernels of new corn into skin, germ and endosperm (starchy and hard part) showed their proportion by weight and their percentage composition to be as follows:

Composition of Different Parts of Maize Kernel (per cent.).

	Original kernel.	Skin.	Germ.	Endosperm.
Proportion in 100 parts of the kernel,	100.00	5.56	10.17	84.27
Composition:				
Water,	24.74	15.29	29.62	24.66
Water-free substance,	75.26	84.71	70.38	75.34
Composition of water-free substance:				
Ash,	1.73	1.27	11.13	0.68
Protein,	12.65	6.60	21.71	12.23
Fiber,	2.02	16.45	2.88	0.65
Nitrogen-free extract (chiefly starch),	79.26	74.09	34.66	84.90
Fat,	4.34	1.59	29.62	1.54

* 15th Ann. Rep., N. J., Agr. Exp. Station, p. 133.

On the basis of these figures, the distribution of materials of the constituents in 100 pounds of the new corn is as follows:

Distribution of Constituents of Maize Kernel Among Its Parts.

	In entire grain, lbs.*	In skin, lbs.	In germ, lbs.	In endosperm, lbs.
Water,	24.64	.85	3.01	20.78
Dry matter,	75.36	4.71	7.16	63.49
Components of dry matter:				
Ash,	1.29	.06	.80	.43
Protein,	9.62	.31	1.55	7.76
Fiber,	1.39	.77	.21	.41
Nitrogen-free extract,	59.87	3.50	2.48	53.91
Fat,	3.17	.07	2.12	.98

* Computed by adding the results for the three portions of the grain.

These figures show that despite the imperfect separation of the skin, it contains over half of the entire fiber of the kernel, and very little of the protein, fat and ash. The germ, on the other hand, though it constitutes only one-tenth of the kernel, contains two-thirds of the fat and ash, and nearly one-sixth of the protein. The endosperm, forming nearly seven-eighths of the entire kernel, contains about four-fifths of the protein, one-third of the ash, fiber and fat, and nine-tenths of the starch and related matters.

The consequences of these differences in composition of the several parts of the kernel are seen in the make-up of the numerous by-products of corn that are left when a portion of the kernel is abstracted for the manufacture of starch, glucose or some of the numerous breakfast foods that are made from this grain.

Shelled Corn.

Among the samples submitted for examination were the following lots of shelled corn:

No.	Manufacturer.	Price per ton.
161	Clapper Bros., Martinsburg, Pa.,	$21 00
186	R. Lee Walker, Duncansville, Pa.,	16 79

Their percentage composition was as follows:

Number.	Moisture.	Protein.	Fat.
161,	10.14	9.19	4.45
186,	10.76	9.13	4.11

These percentages are well within the range for dent corn, though not up to the average.

Cracked Corn.

A sample sold under the name "Fine Cracked Corn for Young Chicks," selling at $19.00 per ton, was taken from the manufacturers, Snyder Bros., Dalton, Pa. Its composition is as follows:

Number.	Moisture.	Protein.	Fat.
143,	9.95	9.00	2.47

The proportion of fat is lower than any recorded in Jenkins and Winton's tables of American analyses.

Corn Chop and Meal.

A considerable series of samples have been examined representing both the coarser "chops" and the more finely ground "meal" sold in the State. Among the samples labeled as "corn chop" are a number, manufactured by the Pittsburg Milling Co., that, from their large proportion of fat, are classed more properly as "hominy chops." Their analyses are therefore presented with those of the latter class of materials.

The sources of the several samples are as follows:

Corn Chop.

No.	Manufacturer.	Dealer.	Price per ton.
175	Bare Milling Co., Roaring Spring, Pa.,	Bare Milling Co.,	....
274	Levi Brant, Harrisburg, Pa.,	Levi Brant,	$20 00
200	Central Elevator Co., Pittsburg, Pa.,	McClelland & Siple,	22 00
232	Central Elevator Co., Pittsburg, Pa.,	C. Beckert,	18 50
188	Clapper Bros., Martinsburg, Pa.,	Clapper Bros.,	20 00
41	H. F. Dry, Oley, Pa.,	A. N. Kissinger & Son., Reading, Pa.,	25 00
62	H. H. Gring, Mohnsville, Pa.,	H. H. Gring,	21 00
57	David Hartz, Morgantown, Pa.,	David Hartz,	19 00
158	H. W. Lecrone, Duncansville, Pa.,	H. W. Lecrone,	19 00
189	C. E. Lingafelt, Hollidaysburg, Pa.,	C. E. Lingafelt,	19 00
206	R. S. McCague & Co., Pittsburg, Pa.,	W. W. Cleland,	20 00
19	McDermott, Wertz & Co., Johnstown, Pa.,	Gustave Bostert, Johnstown, Pa.,	19 00
173	F. & I. Mentzer, Frankstown, Pa.,	F. & I. Mentzer,	22 00
210	Pittsburg Milling Co., Pittsburg, Pa.,	C. Kelner, Allegheny, Pa.,	20 00
157	R. Lee Walker, Duncansville, Pa.,	R. Lee Walker,	19 00
172	G. P. Wilt, Blair's Gap Mills, Duncansville, Pa.	G. P. Wilt,	19 00

Corn Meal.

No.	Manufacturer.	Dealer.	Price per ton.
207	Altman Mills, Toledo, O.,	Peter Bock, Pittsburg,	$21 00
245	D. H. Beebe, Corry, Pa.,	D. H. Beebe,	19 00
67	Eclipse Milling Co., Brownsville, Pa.,	Eclipse Milling Co.,	10 00
70	Gaddis & Co., Uniontown, Pa.,	M. H. Clarke, Uniontown, Pa.,	20 00
[illegible]	[illegible]	[illegible]	......
205	Pittsburg Milling Co., Pittsburg, Pa.,	M. E. Coleman, East End, Pittsburg Pa.,	20 00
231	Pittsburg Milling Co., Pittsburg, Pa.,	Chas. Friel, Pittsburg, Pa.,	22 00
150	C. H. Sears, Clark's Summit, Pa.,	C. H. Sears,	19 00
47	Geo. S. Snyder, Hatfield, Pa.,	A. N. Kissinger & Son, Reading, Pa.,	26 00
139	Snyder Bros., Dalton, Pa.,	Snyder Bros.,	19 00
208	Toledo Grain & Milling Co., Toledo, O.,	M. E. Coleman, Pittsburg, Pa.,	21 00
28	C. W. Walter, Walters, Pa.,	C. W. Walter,	18 00
77	Warner Bros., Grant Station, N. Y.,	Warner Bros.,	21 00
82	Warren Mills, Warren, Pa.,	Warren Mills,	19 00
129	Weston Mill Co., Scranton, Pa.,	Weston Mill Co.,	19 00

Percentage Composition of Corn Chops and Meals.

No.	Description.	Moisture.	Protein.	Fat.
	Corn Chop.			
175	Pure corn chop,	10.70	9.19	3.97
[illegible]	[illegible]	11.11	[illegible]	[illegible]
260	Corn chop (coarse meal),	9.99	9.44	4.35
232	Corn meal "chop",	9.90	9.63	3.78
188	Pure corn chop,	10.00	7.50	4.27
41	Clear corn chop,	11.20	9.13	4.39
62	Pure corn chop,	10.98	8.44	3.98
57	Pure corn chop,	11.23	8.31	4.92
158	Pure corn chop,	10.29	9.06	3.89
189	Corn chop,	10.18	9.50	4.00
266	Corn meal "chop",	10.69	8.81	3.73
19	Corn chop,	11.50	9.56	3.98
173	Pure corn chop,	10.23	9.13	4.24
210	Yellow corn "meal chop",	10.50	8.88	3.41
157	Corn chop,	10.23	9.69	4.18
172	Corn chop,	10.52	9.44	4.18
	Range,	9.90-11.50	7.50-9.69	3.41-4.39
	Average,	**10.58**	**9.06**	**4.03**
	Corn Meal.			
207	Corn meal,	10.04	8.00	3.85
245	Corn meal,	10.00	9.31	3.89
67	Corn meal,	10.73	8.81	3.58
70	Corn meal,	11.43	7.94	3.05
169	Corn meal (not descriptively named),	10.81	9.31	4.26
205*	Corn meal, white,	7.77	10.75	8.39
231	Corn meal,	9.12	10.13	5.04
150	Corn meal,	10.39	9.00	4.09
47†	Granulated corn meal,	11.75	8.38	.97
139	Corn meal,	9.90	9.38	4.05
208	Corn meal, yellow,	9.77	7.75	3.18
28	Corn meal,	11.40	8.56	3.99
77	Corn meal,	12.15	8.69	3.82
82	Corn meal,	12.14	9.31	3.76
129	Corn meal,	9.81	9.13	3.95
	Range, omitting Nos. 47 and 205,	9.12-12.15	7.75-10.13	3.05-5.04
	Average, omitting Nos. 47 and 205,	**10.59**	**8.87**	**4.66**

* Evidently a hominy meal.
† Oil deficient.

Excluding Nos. 205 and 47 as special products, evidently not produced by a simple milling process, we may compare the composition found for the Pennsylvania samples, with those obtained elsewhere:

Composition of Corn Crop in Different States (per cent.).

	Number of analyses.	Protein.			Fat.		
		Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Pennsylvania samples:							
Chop,	15	9.69	7.50	9.06	4.39	3.41	4.03
Meal,	12	10.13	7.75	8.83	5.01	3.05	4.19
United States:							
Analysis completed by Jenkins and Winton (1892)—Meal,	77	13.9	7.1	9.2	5.1	2.0	3.8
New England States (1898-9),	17	10.8	8.6	9.5	4.7	2.7	4.0

All samples fall within the established limits of variation. There is a general tendency for the corn meals to run low in protein.

No. 205 belongs rather to the class of "hominy chops," as its high percentage of fat indicates.

A microscopic examination shows:

No. 157. Contains some portions of cob, but possibly no more than might be due to careless cleaning after shelling.

No. 172. Contains cob, like No. 157, and also contains a small, but considerable proportion of oat hulls. Oat kernels were not found.

No. 231. Contains a few whole oats, evidently an accidental mixture.

Corn-and-Cob Chops.

The chopping of the cob with the kernel results in the production of a very different food, because of the highly different composition of the cob as well as because of its bulkiness. Eighteen American analyses of the cob compiled by Jenkins and Winton, exhibit the following percentages:

	Mean.	Highest.	Lowest.
Moisture,	10.7	24.8	7.2
Ash,	1.4	2.7	0.7
Protein,	2.4	3.7	1.2
Fiber,	30.1	38.1	18.2
Nitrogen-free extract,	54.9	66.7	48.8
Fat,	0.5	0.9	0.1
	100.00	....	....

Not only is the protein barely one-fourth as abundant as in the kernel and the fat but one-tenth as much, but the fiber is fourteen times as great in amount; moreover, the nitrogen-free extract of the cob, instead of being composed, like that of the grain, chiefly of starch, is largely made up of less valuable pentosans.

The proportion of cob to kernel in well developed dent corn varies little from 14 pounds in 70 pounds of ears, or one part of cob to four of shelled corn.

Figuring on this proportion and upon the basis of the average composition of dent kernel and of cob given above, the mean composition of corn-and-cob meal should be:

	Per cent.
Moisture,	10.6
Ash,	1.5
Protein,	8.7
Fiber,	7.8
Nitrogen-free extract,	67.3
Fat,	4.1
	100.00

Six samples of this material were submitted for analysis, taken from the following sources:

No.	Manufacturer.	Dealer.	Price per ton.
53	M. C. Dietrich, Kempton, Pa.,	M. C. Dietrich,	$14 50
185	H. W. Lecrone, Duncansville, Pa.,	H. W. Lecrone,	16 00
191	C. E. Lingafelt, Hollidaysburg, Pa.,	C. E. Lingafelt,	17 00
151	F. & I. Mentzer, Frankstown, Pa.,	F. & I. Mentzer,	17 00
64	John H. Schmehl, Scarlett's Mills,	John H. Schmehl,	18 00
35	C. W. Walter, Walter's, Pa.,	C. W. Walter,	15 00

Percentage Composition of Corn-and-Cob Chops.

No.	Description.	Moisture.	Protein.	Fat.
53	Corn-and-cob chop,	10.77	7.56	3.52
185	Ear corn chop,	10.06	7.81	3.44
191	Corn-cob and all,	10.39	7.81	3.48
151	Two-thirds ear, one-third shelled corn chop,	10.62	8.50	3.31
64	Corn-cob chop,	11.15	6.88	3.31
35	Cob feed,	11.44	6.94	3.45
	Range,	10.06-11.44	6.88-8.50	3.31-3.52
	Average,	10.74	7.58	3.42
	Average, omitting No. 151,	**10.76**	**7.40**	**3.44**

New England Control reports do not discuss this feeding stuff. Jenkins and Winton compiled the results of seven analyses made prior to 1892. They compare with the foregoing, omitting No. 151, as follows:

	Number of samples.	Protein, per cent.			Fat, per cent.		
		Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Pennsylvania,	5	7.81	6.88	7.40	3.52	3.31	3.44
United States,	7	12.2	5.8	8.5	4.7	2.5	3.5

These analyses are therefore about normal, though, as in case of the corn meal, the tendency is toward a low protein average.

No. 151 is found, upon examination, to contain a large proportion of oat hulls, which, selling under the name given to this sample, constitutes a serious adulteration notwithstanding the fact that the material contains more protein than the other corn-and-cob meals.

Gluten, Gluten Meal and Gluten Feed.

These are by-products from the manufacture of starch and glucose from corn.*

The process is essentially as follows: The corn is soaked for some hours in a weak solution of sulfurous acid. In the resulting softened condition it is ground, the ground products being carried off in the water. The germ or chit floats on the surface and is gathered by skimming. The starch and gluten are carried off in the water and deposit separately because the starch is heavier, the hull having been previously separated by passing the water through sieves. The starch thus separated is the main product. The other materials are deprived of most of their moisture by pressure and then kiln-dried.

The gluten meal is sometimes sold by itself; often in combination with the husk or bran, and sometimes the "chit" or germ, as "gluten feed." The composition of these by-products is subject to a further variation from the fact that, in some factories, the corn oil is partially removed. When the germ is kept apart, it is frequently deprived of a large fraction of its oil by hydraulic pressure; the press-

* The so-called "Atlantic gluten meal" is an exception, being derived instead as a by-product of the manufacture of wheat-starch. It contains 48.9 per cent. of protein and 7.9 per cent. of fat.

cake is then sold as germ oil cake. The bran also is often sold as a separate food-stuff.

Owing to the large amounts of water used in these separations, the several products are exhausted of a large portion of their soluble mineral matters, chiefly phosphate of potassium.

No samples of genuine "gluten meal,"* were submitted, though several samples of gluten feed were received under the label "gluten." The samples of gluten feed received were:

No.	Manufacturer.	Dealer.	Price per ton.
149	American Glucose Co., Chicago,	Snyder Bros., Dalton, Pa.,	$18 50
116	Buffalo Sugar Refining Co., Buffalo, N.Y.,	M. A. Kirby,	16 00
240	Buffalo Sugar Refining Co., Buffalo, N.Y.,	R. S. McCague, Pittsburg, Pa.,	18 00
31	Glucose Sugar Refining Co., Peoria, Ill.,	C. W. Walter, Walters, Pa.,	18 00
43	Glucose Sugar Refining Co., Chicago., Ill.	A. N. Kissinger & Son, Reading, Pa.,	20 00
282	Glucose Sugar Refining Co., Chicago, Ill.	John B. Curry, Swatara Sta., Pa.,	18 50
107	Glucose Sugar Refining Co., Chicago, Ill.	Morris Briggs, Woodbourne, Pa.,	19 00
55	Glucose Sugar Refining Co., Rockford, Ill.	Mahlon C. Dietrich,	18 00
81	....	Warren Mills Co., Warren, Pa.,	18 00
118	....	Trenton Milling Co., Morrisville, Pa.,	20 00
137	....	C. H. Sears, Clark's Summit,	19 00
243	....	Crouch Bros., Erie, Pa.,	17 00

Percentage Composition of Gluten Feeds.

No.	Description.	Moisture.	Protein.	Fat.
149	Gluten feed,	8.67	24.31	3.44
116	Coarse gluten,	7.86	13.88	3.04
240	Gluten feed,	8.55	25.75	2.43
31	Gluten feed,	9.11	25.19	3.16
43	Gluten feed,	9.84	26.56	2.19
282	Buffalo gluten feed,	8.46	26.75	2.53
107	Gluten,	8.08	26.50	2.41
55	Gluten feed,	9 15	24.00	3.53
81	Gluten feed,	9.08	27.00	2.76
118	Gluten,	8.48	25.19	3.55
137	Gluten feed,	9.14	25.94	2.68
243	Gluten feed,	8.19	25.75	2.38
	Range,	7.86-9.84	13.88-27.00	2.19-3.55
	Average,	9.72	24.72	2.84

The average composition of gluten meal derived from corn is stated by Jenkins and Winton as:

	Per cent.
Water,	9.6
Ash,	0.7
Protein,	29.4
Fiber,	1.6
Nitrogen-free extract,	52.4
Fat,	6.3
	100.0

* Later analyses show an average of 36.7 per cent. protein and 2.7 per cent. fat for Chicago gluten meal, and 34.1 per cent. protein and 3.2 per cent. fat for "cream gluten."

There was no microscopic evidence of adulteration of these materials.

It is interesting to note that "gluten meal" is not included among the samples secured and that "gluten feed" is in quite a number of cases described by the generic name "gluten." Yet among the samples recently analyzed by the New England States, there were 118 gluten meals and 79 gluten feeds.

On considering the composition of No. 116, it is clear that the name "coarse gluten" is a misbrand. The material corresponds better to "fancy corn bran" which is sold by the Glucose Sugar Refining Company in New York State under a guaranty of 13.5 per cent. protein and 3 per cent. fat.

There are a number of brands of gluten feed upon the market. The general tendency of business consolidation has been toward a greater uniformity in production, certainly toward a diminution in the number of brand names for the same general product.

Since the names secured by the sampling agents do not clearly indicate the brand names of these goods, our comparisons will be confined to the gluten feeds whose manufacturers are named, practically all coming from the Glucose Sugar Refining Company's factories.

Comparative Composition of Gluten Feeds in Different States.

	Number of analyses.	Protein, per cent.			Fat, per cent.		
		Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Pennsylvania:							
All analyses (except 116), ...	11	27.00	24.00	25.71	3.55	2.19	2.64
Glucose Sugar Refining Company's brands, ...	7	26.75	24.00	25.58	3.53	2.19	2.81
New England, 1898-99:							
Buffalo gluten feed, ...	34	29.6	25.3	27.5	4.7	2.3	3.1
Diamond gluten feed, ...	30	30.1	20.3	23.6	4.0	2.0	3.0
New York, 1899:							
Buffalo gluten feed, ...	6	27.63	21.31	26.10	4.67	3.38	3.71
Diamond gluten feed, ...	2	20.56	20.00	20.28	5.21	3.40	4.30
All analyses, 1900, ...	21	....	....	23.75	....	....	4.55
Buffalo gluten feed, 1900, ...	3	27.0	24.1	25.9	5.0	2.9	3.9
Diamond gluten feed, 1900, ..	3	25.9	24.4	25.3	3.6	2.8	3.2

The composition guaranteed in New York for the year 1900 for the Buffalo, Diamond, Davenport and Marshalton brands was protein 27 per cent., fat 3.3 per cent.

The gluten feed sold in Pennsylvania seems to be chiefly of the Buffalo brand. Judging from the results of analysis in neighboring

States having food controls, the goods sold in Pennsylvania is somewhat inferior, on the average, to those sold where the law requires a guaranty of composition and provides the means for chemical examination of the foods.

Germ Oil Cake.

A single sample of "germ oil cake," manufactured by the Glucose Sugar Refining Co., of Chicago, and purchased from W. K. Heebner, West Point, Pa., at $22.50 per ton, shows the following percentage composition:

	Per cent.
Moisture,	9.67
Protein,	22.56
Fat,	9.77

By the removal of three-fourths of its moisture and of two-thirds of its fat by drying and pressing, a germ having the original composition shown in Voorhees's analysis, would yield a cake containing 11.71 per cent. moisture, 23.94 per cent. protein and 10.99 per cent. fat, quantities a little higher than those shown in the market sample; but the corn examined by Voorhees was exceptionally rich in protein.

Under the name "germ oil meal" the Glucose Sugar Refining Company offers a feeding stuff guaranteed to contain 25 per cent. protein and 10.5 per cent. fat. The foregoing sample falls considerably under this guarantee in both constituents.

Corn Bran.

Three samples of this material were submitted:

No.	Manufacturer.	Dealer.	Price per ton.
101	Marfield & Co., Chillicothe, O.,	W. K. Heebner, West Point, Pa.,	$16 00
98	———, Nashville, Tenn.,	W. K. Heebner, West Point, Pa.,	18 00
88	———, Nashville, Tenn.,	Simpson Bros., Norristown, Pa.,	18 00

The percentage composition of these samples was as follows:

No.	Description.	Moisture.	Protein.	Fat.
101	White corn bran, fine,	11.42	9.44	6.88
98	White corn bran, coarse,	8.85	11.50	12.07
88	White corn bran,	9.73	11.31	12.17
	Range,	8.85-11.42	9.41-11.50	6.88-12.17
	Average,	**10.00**	**10.75**	**10.37**

There are few data available for comparison with these analyses. The following may suffice:

	Number of analyses.	Protein, per cent. Highest.	Protein, per cent. Lowest.	Protein, per cent. Average.	Fat, per cent. Highest.	Fat, per cent. Lowest.	Fat, per cent. Average.
New Jersey, 1894,	3	11.83	10.16	10.97	8.32	3.75	6.64
New York, 1900,	1	11.9	9.2	10.05	7.9	4.3	6.1
Pennsylvania,	3	11.50	9.44	10.75	12.17	6.88	10.37

The Pennsylvania samples are marked by the possession, in two cases out of three, of an exceptionally high proportion of corn-oil. In all these cases, the fat or oil, and the protein also, so far exceeds that found by Voorhees in the true skin or bran, that it is clear a very considerable proportion of the germ must remain with the true bran in the goods marketed under the latter name.

Sugar Feed.

A single sample of this name, No. 90, described as manufactured in Chicago, Ill., and sold by Simpson Bros., of Norristown, Pa., at $16 per ton, was received, with the accompanying statement that dairymen feeding it, believe it is giving good results.

The analysis is as follows:

	Per cent.
Moisture,	9.76
Protein,	7.94
Fat,	7.40
Reducing sugar, calculated as dextrose,	.90

Optical examination shows this to be a coarse corn-bran, from white corn, with no considerable quantity of finely divided material; the microscope shows no foreign starches present. The food is, as both the analysis and optical examinations show, corn bran.

Sugar Corn Feed.

A single sample of this product was submitted, described as manufactured by The Glucose Sugar Refining Co., Chicago, Ill., and sold by The Sims Co., Erie, Pa., at $14.00 per ton. A guaranty of 10.07 per cent. protein and 3.90 per cent. fat, accompanied the sample.

The analysis gave the following figures:

	Per cent.
Moisture,	8.41
Protein,	12.81
Fat,	2.72

A sample sold under this brand name, made by the same company, and guaranteed to contain 13.5 per cent. protein and 3 per cent. fat, was analyzed by the New York Experiment Station (Bulletin 176, p. 29) with the following results:

	Per cent.
Protein,	11.8
Fat,	5.8

Other samples of feeding stuffs sold under this name, but concerning whose manufacturer no information is given, have been analyzed recently as follows:

Moisture.	Protein.	Fat.	Laboratory.
....	12.3	5.2	N. Y. Station, B. 176, p. 29.
....	8.6	7.9	N. Y. Station, B. 176, p. 29.
9.96	11.25	5.12	N. Y. Station, B. 166, p. 264.*
....	10.00	4.57	R. I. Sta., B. 63, p. 100.

*This sample contained 11.91 per cent of crude fiber.

Comparison of these analyses with that of corn bran show a quite close resemblance between this feeding-stuff and the bran in their richness in protein and fiber, though the fat is considerably more abundant on the average in the bran. Furthermore, the feed does not seem to be very uniform in composition, quite marked variations from guaranty being observed in both instances where a guaranty was given.

Hominy Chop.

Under this name and the terms "white meal," "hominy feed" and "Baltimore meal," is sold a by-product from the manufacture of hominy. In making the hominy, the hard, inner portion of the grain is removed, while the hull, germ and portions of the starchy part of the kernel are combined to form the cattle food.

Two samples were submitted:

No.	Manufacturer.	Dealer.	Price per ton.
145	Weston Mill Co., Scranton, Pa., ...	Weston Mill Co., ...	$20 00
250	....	Crouch Bros., Erie, Pa., ...	17 00

Analysis (per cent.)

No.	Description.	Moisture.	Protein.	Fat.
145	Hominy chop,	8.44	11.25	9.78
250	Hominy,	8.99	10.25	7.40

The Connecticut Station (B. 130, p. 33), gives a summary of eight complete analyses of these materials:

	Per cent.
Moisture,	8.43
Ash,	2.60
Protein,	11.35
Fiber,	4.92
Nitrogen-free extract,	64.64
Fat,	8.06

So that, having about six or seven per cent. less fiber than corn bran and about five per cent. more starchy matter, the hominy chops more nearly resemble entire corn meal in composition; practically it differs from the corn itself only in having a few per cent. less starch and relatively more of the other valuable components.

From their composition it is evident that a number of samples whose brand name indicates that they may be simply ordinary corn chop, belong rather among the hominy chops. They are the following:

No.	Manufacturer.	Dealer.	Price per ton.
204	Pittsburg Milling Co., Pittsburg, Pa.,	Brown & Co., Pittsburg, Pa.,	$20 00
202	Pittsburg Milling Co., Pittsburg, Pa.,	Wm. Fisher, Pittsburg, Pa.,	18 00
224	Pittsburg Milling Co., Pittsburg, Pa.,	D. Whitmyer, Allegheny, Pa.,	18 00
225	Pittsburg Milling Co., Pittsburg, Pa.,	C. Kelner, Allegheny, Pa.,	19 00
219	Pittsburg Milling Co., Pittsburg, Pa.,	Wm. Fisher, Pittsburg, Pa.,	20 00
238	Pittsburg Milling Co., Pittsburg, Pa.,	D. Whitmyer, Allegheny, Pa.,	19 00

Their percentage composition is as follows:

No.	Description.	Moisture.	Protein.	Fat.
204	Corn chop,	7.96	11.19	9.23
202	White corn chop,	8.65	11.00	9.21
224	White corn chop,	8.19	10.75	8.93
225	White corn meal chop,	8.35	11.19	8.97
219	Yellow corn chop,	9.00	10.69	8.54
238	Yellow corn chop,	8.32	11.50	9.32

The differences in selling price of these goods are not strictly in accordance with their composition.

Microscopic examination of these samples gives the following results:

No. 224. Is coarse ground; contains, in addition to coarse particles of the corn bran, occasional bits of oat hull and quite a little corn cob, though possibly not more than would result from imperfect cleaning of the kernel during the process of shelling.

No. 219. Contains a very noticeable quantity of oat hulls.

No. 238. Like No. 219, is evidently made by blending several materials. Considerable oat hull and more corn cob than a good clean article of corn should yield, are present. The major portion of the corn bran and grain is white, but numerous small yellow particles, either of the pure endosperm, or of its more highly nitrogenous portion, of yellow corn is present.

In composition, at least as regards their richness in protein and fat, these samples do not differ conspicuously from the others of the same group.

Cerealine Feeds.

These are by-products from the manufacture of "cerealine" breakfast foods and are made from white corn exclusively.

The samples submitted are:

No.	Manufacturer.	Dealer.	Price per ton.
99	Cerealine Manufacturing Co., Indianapolis, Ind.	W. K. Heebner, West Point, Pa., ...	$17 00
135	Cerealine Manufacturing Co., Indianapolis, Ind.	C. H. Sears, Clark's Summit, Pa.,....	19 00
94	Cerealine Manufacturing Co., Indianapolis, Ind.	W. K. Heebner, ...	18 00

The percentage composition of the samples is:

No.	Description.	Moisture.	Protein.	Fat.
99	Cerealine Feed, No. 1, ...	8.49	11.75	9.75
135	Cerealine Feed, No. 1, ...	8.99	9.94	7.62
94	Cerealine Feed, No. 2 (?), ...	9.95	25.88	2.69

The composition of Feed No. 1 is similar to that of hominy chop; that of the sample purporting to represent Feed No. 2, resembles gluten feed. No guaranties accompany the descriptions of these feeds, but the guaranties given in New York State during the year 1900 are as follows:

	Protein, per cent.	Fat, per cent.
Cerealine Feed, No. 1,	9.00	5.82
Cerealine Feed, No. 2,	10.31	8.62

A single sample of No. 2 analyzed by the New York Station is in harmony with the guaranty. It seems practically certain therefore that the description of Sample No. 94 is erroneous.

Microscopic examination shows nothing noteworthy.

BUCKWHEAT AND ITS BY-PRODUCTS.

Buckwheat is the source of a number of by-products of the widest difference in feeding value. The grain is composed of a thick, dark brown hull, made up of four layers of different tissue; the grain proper is covered by a thin branny coating, under which lies a layer of aleurone cells, rich in protein like those of the common cereals, and finally, lying within this layer, is found the endosperm from which the flour is made. The milling products, properly classified, are as follows:

1. The flour, including the endosperm with as little as possible of the other layers.
2. The middlings, composed in part of the endosperm and aleurone, layer, and containing a portion of the true seed coat.
3. The bran, composed chiefly of the true seed coat, with small portions of the aleurone layer and endosperm.
4. The hulls.
5. Buckwheat feed composed of hulls and bran or middlings, often with a portion of the hard outer layer of the hull removed.

The general percentage composition of the several principal parts of the grain, as separated by milling, is as follows:

	Flour.	Middlings.	Bran.	Hulls.
Moisture,	14.6	13.2	9.2	8.0
Ash,	1.0	4.8	5.0	2.5
Protein,	6.9	28.9	30.4	5.8
Fiber,	0.3	4.1	4.9	37.7
Nitrogen-free extract,	75.8	41.9	41.9	44.4
Fat,	1.4	7.1	8.6	1.6

That is to say, there is very little difference between the bran and middlings in practice. The hulls are woody and of low digestibility; they possess little feeding value.

Two samples of buckwheat were received for analysis:

No.	Manufacturer.	Dealer.	Price per ton.
128	Snyder Bros., Dalton, Pa.,	Snyder Bros.,	$40 00
141	Snyder Bros., Dalton, Pa.,	Snyder Bros.,	18 00

Their description and composition are as follows:

No.	Description.	Moisture	Protein.	Fat.	Remarks.
128	Buckwheat flour,	11.59	5.88	1.06	Microscopically pure.
140	Buckwheat middlings,	10.00	31.06	8.77	Contains considerable proportion of hulls.

The flour, No. 128, is exceptionally free from particles of the exterior layers of the grain and is absolutely without foreign admixture. The "middlings" is, properly speaking, "buckwheat feed." Its composition is up to that of average buckwheat middlings, but it contains a considerable proportion of hulls which cannot, by any stretch of courtesy, be allowed sale under the name "bran" or "middlings." This is a case of adulteration with very little of fraud if the goods be sold after examination, because the least experienced buyer, if he were acquainted with the proper meaning of the term middlings, could not fail to note the presence of the coarse hulls.

MIXED FEEDS.

Corn and Oat Feeds.

Properly, these feeding stuffs should be composed of a mixture of ground corn and ground oats, but very frequently large proportions of the relatively valueless hulls are admixed.

The average percentages of fat in corn and oats are the same, and those of protein are so nearly the same that there is only one-half per cent. more protein in a corn-and-oats chop containing two parts of oats to one of corn, than in a chop made from one part of oats to two of corn. A chop made from equal parts of oats and corn, such as is called "provender" in New England, should contain about 11.1 per cent. of protein and 5.0 per cent. of fat.

The following samples were received:

No.	Manufacturer.	Dealer.	Price per ton
97	American Cereal Co., Akron, O.,	W. K. Heebner, West Point, Pa.,	$18 00
280	American Cereal Co., Chicago, Ill.,	John B. Curry, Swatara Station, Pa.,	18 00
283	American Cereal Co., Chicago, Ill.,	Cyrus Romberger, Lykens, Pa.,	18 00
252	D. H. Beebe, Corry, Pa.,	D. H. Beebe, Corry, Pa.,	19 00
235	The Central Elevator Co., Pittsburg, Pa.,	L. W. Kartlick, 22 Penn Ave., Pittsburg, Pa.,	18 00
156	Clapper Bros., Martinsburg, Pa.,	Clapper Bros.,	20 00
247	Densmore Bros., Erie, Pa.,	Densmore Bros.,	18 00
42	H. F. Dry, Oley, Pa.,	A. N. Kissinger & Son, Reading, Pa.,	21 00
78	D. H. Grandin, Jamestown, N. Y.,	D. H. Grandin,	23 00
59	David Hartz, Morgantown, Pa.,	David Hartz,	20 00
258	F. L. Heath, Corry, Pa.,	F. L. Heath,	[illegible]
50	James Heffner, Kutztown, Pa.,	Chas. W. Pennock, Reading, Pa.,	18 00
177	C. E. Lingafelt, Hollidaysburg, Pa.,	C. E. Lingafelt,	19 00
13	McDermott, Wertz & Co., Johnstown, Pa.,	McDermott, Wertz & Co.,	20 00
16	McDermott, Wertz & Co., Johnstown, Pa.,	Gustav Bostert, Johnstown, Pa.,	19 00
23	Toledo Grain and Milling Co., Toledo, O.,	Pennsylvania Traffic Co., Ltd., Johnstown, Pa.,	21 00
214	Toledo Grain and Milling Co., Toledo, O.,	M. E. Coleman, 6114 Centre Avenue, Pittsburg, Pa.,	21 00
181	R. Lee Walker, Duncansville, Pa.,	R. Lee Walker,	20 00
271	(Manufactured near Middletown, Pa.),	S. B. Vance, Middletown, Pa.,	22 00

The percentage composition of these samples is as follows:

No.	Description.	Moisture.	Protein.	Fat.
97	Victor corn and oat feed,	10.33	8.38	3.42
280	Victor corn and oat feed,	9.99	7.88	3.28
283	Victor corn and oat feed,	9.17	7.88	4.07
252	Corn and oat feed,	9.87	9.00	3.72
235	Corn and oats chop,	9.62	9.25	4.26
156	Corn and oats chop,	9.63	8.69	3.97
247	Corn and oats chop,	10.13	8.94	3.52
42	Corn and oats chop,	10.34	8.63	3.95
78	Corn and oats,	11.44	8.44	3.58
59	Corn and oats (one-third corn, two thirds oats),	12.10	9.88	4.17
258	Oats and corn chop,	9.94	9.63	4.19
50	Corn and oats,	11.12	9.25	4.05
177	Corn and oats,	10.34	9.31	3.76
13	Corn and oats,	12.26	9.19	3.92
16	Corn and oats,	11.66	9.31	4.10
23	Corn and oats,	11.53	8.00	3.41
214	Corn and oats chop,	10.20	7.81	2.97
181	Corn and oats,	10.17	9.44	3.58
152	Corn and oats chop,	10.07	9.00	4.08
271	Corn and oats chop,	10.28	8.56	3.44
	Range,	9.17-12.26	7.81-9.88	2.97-4.26
	Average,	**10.51**	**8.82**	**4.27**

Not one of these feeds reaches, in either constituent, the average percentage for unadulterated corn and oats. On the other hand, both grains are sufficiently variable in composition to make it possible that any one of these feeds might have been made by mixing exceptionally poor lots of the two grains. Admitting this as a possibility in individual cases, it is nevertheless safe to say, upon the basis of these analyses, that there is almost no pure corn-and-oats feed on sale in the State and that the practice of diluting by admixture of oat hulls is well nigh universal. Assuming average composition for the three materials, a mixture of 58 parts corn, 31

parts oats hulls and 11 parts oats would contain about 8.8 per cent. of protein and 3.7 per cent. of fat. When it is considered that small quantities of corn cob are found in many of these samples, as in Nos. 97, 283, 259 and 214, whether purposely added or remaining after an imperfect cleaning of the corn after shelling, the possibilities of variation are more clearly perceived.

When it is seen that the average composition of these mixtures is about the same, or a little inferior in fat content, to that of the corn meal, that a very considerable proportion of the corn and oat feeds is composed of oat hulls whose nitrogen-free extract is much less digestible than corn, and yet that the average price paid for these feeds is about $19.60, while that paid for corn chops and meals is $19.35, the advantage of economy is seen to lie with the unmixed corn.

Of the brands examined, Victor Corn and Oat Feed is the only one analyzed in other States. The comparative data for this brand are:

	Number of analyses.	Protein, per cent.			Fat, per cent.		
		Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Victor corn and oat feed:							
Pennsylvania,	2	7.88	7.88	7.88	4.07	3.28	3.68
New York, 1900,	4	8.7	7.1	8.1	4.6	2.9	4.78
New England, 1898-9,	26	11.3	9.5	9.2	5.1	2.9	3.9
All brands:							
Pennsylvania,	20	9.88	7.81	8.82	4.26	2.97	4.27
New York, 1899-1900,	17	9.37	6.8	8.03	4.6	1.6	3.22
New England, 1898-9,	43	12.3	8.2	9.3	7.1	2.7	3.8

In New York, 1900, the Victor brand was guaranteed to contain 8.23 per cent. protein and 3.00 per cent. fat. The New York analyses are up to this guarantee. A careful consideration of the above data shows that Pennsylvania receives goods of this class inferior, on the average, to those of New York, where the selling price is somewhat less, and that in both these States this class of goods is less rich than in New England, where systematic inspection of cattle foods has been longer practiced.

Closely related to the foregoing feeds are two other samples;

No. 80. Corn and oats hulls; made and sold by the Warren Mills Co., Warren, Pa., at $19.00 per ton.

No. 192. Corn and cob meal and oats; made and sold by Clapper Bros., Martinsburg, Pa., price not given.

The percentage composition of these goods was:

Number.	Moisture.	Protein.	Fat.
80,	11.62	8.63	3.12
192,	9.52	9.13	3.67

That is, these brands do not differ in composition from others sold under more misleading names.

Though sold under different names, the following feeds are also closely related to the foregoing:

No.	Manufacturer.	Dealer.	Price per ton.
124	Weston Mill Co., Scranton, Pa.,	Weston Mill Co.,	$21 00
127	Weston Mill Co., Scranton, Pa.,	Weston Mill Co.,	19 00
153			

Analysis gave the following results (per cent.):

No.	Description.	Moisture.	Protein.	Fat.
124	Best mixed feed,	8.61	9.38	4.09
127	Regular mixed feed,	9.76	9.81	4.58
153	No accompanying description,	10.31	9.25	4.01

No. 124 shows, when optically examined, a larger proportion of corn chop than No. 127, and some excess of oat hulls. No. 153 has a preponderance of corn.

Other Mixed Stock Feeds.

In addition to the foregoing, a number of stock foods made of other combinations of materials have been received:

No	Manufacturer.	Dealer.	Price per ton.
155		B. Cohn, Altoona, Pa.,	
168		H. Mulhollen,	
10		I. L. Hoekensmith,	$18 00
48	American Cereal Co., Chicago, Ill.,	Israel S. Fry, Reading, Pa.,	17 00
267	American Cereal Co., Chicago, Ill.,	John B. Curry, Swatara Sta.,	19 00
162	T. M. Biddle, Altoona, Pa.,	T. M. Biddle,	
167	R. L. Walker, Duncansville,	R. L. Walker,	20 00
174	J. S. Brown & Son, Loysburg,	J. S. Brown & Son,	16 00
198	Bare Milling Co., Roaring Spring,	Bare Milling Co.,	
163	P. W. Post, Altoona,	P. W. Post,	25 00
184	R. Lee Walker, Duncansville,	R. Lee Walker,	22 00

No.	Manufacturer.	Dealer.	Price per ton.
178	....	(Sent by H. L. Harvey), ...	....
11	....	James Reeder, ...	16 00
49	James Heffner, Kutztown, Pa., ...	Chas. W. Pennock, Reading, ...	20 00
38	Mann & Allshouse, Easton, ...	Mann & Allshouse, ...	22 00
37	Mann & Allshouse, Easton, ...	Mann & Allshouse, ...	20 00
272	Levi Brant, Harrisburg, Pa., ...	Levi Brant, ...	23 00
170	Clapper Bros., Martinsburg, ...	Clapper Bros., ...	22 00
194	Clapper Bros., Martinsburg, ...	Clapper Bros., ...	24 00
52	M. C Dietrich, Kempton, Pa., ...	M. C. Dietrich, ... ;	22 00
63	H. H. Gring, Mohrsville, ...	H. H. Gring, ...	22 00
160	F. & I. Mentzer, Frankstown, Pa., ...	F. & I. Mentzer, ...	20 00
182	G. W. Mock, Rodman's Mills, Pa., ...	G. W. Mock, ...;	23 00
65	John H. Schmehl, Scarlets Mill, Pa., ...	J. H. Schmehl, ...	20 00
36	C. W. Walter, Walters, Pa., ...	C. W. Walter, ...	22 00
39	C. W. Walter, Walters. Pa., ...	C. W. Walter, ...	18 00
21	American Cereal Co., Chicago, Ill., ...	John Thomas & Son, Johnstown, Pa.,	20 00
68	American Cereal Co., Akron, O., ...	M. H. Clark, Uniontown, Pa., ...	20 00
26	Toledo Grain and Milling Co., Toledo, Ohio.	Pennsylvania Traffic Co., Ltd., Johnstown, ...	21 00
122	Snyder Bros., Dalton, Pa., ...	Snyder Bros., ...	19 00
84	H. O. Company, Buffalo, N. Y., ...	Simpson Bros., Norristown, Pa., ...	22 50
85	H. O. Company, Buffalo, N. Y., ...	Simpson Bros., Norristown, Pa., ...	22 50
112	H. O. Company, Buffalo, N. Y., ...	Frank H. Duffield, Langhorne, ...	20 00
115	H. O. Company, Buffalo, N. Y., ...	Frank H. Duffield, Langhorne, ...	20 00
140	Brooks & Pennock, Philadelphia, ...	Snyder Bros., Dalton, Pa., ...	18 50

The results of chemical and microscopical examination are given below. Under the heading "description" are stated the names under which the goods were sold.

Other Mixed Stock Foods.

Number.	Description.	Moisture, per cent.	Protein, per cent.	Fat, per cent.	Remarks.
	Wheat and Oats.				
155	No description,	9.47	14.94	3.90	
168	No description,	9.37	13.31	6.35	
10	Quaker dairy feed,	8.40	10.94	4.73	Contains white corn; oat hulls.
48	Quaker dairy feed,	8.72	12.88	2.94	No corn found.
267	Quaker dairy feed,	8.05	9.00	2.82	Wheat dust abundant.
	Range,	8.05-9.47	9.00-14.94	2.82-6.35	
	Average,	**8.80**	**12.23**	**4.15**	
	Wheat and Corn.				
162	Mixed feed,	10.19	8.69	3.77	Chiefly corn.
167	Corn and middlings,	10.13	12.88	4.30	A few oats present.
174	Mixed feed,	9.98	11.19	3.64	Chiefly bran with corn meal.
	Range,	9.98-10.19	8.69-11.19	3.64-4.30	
	Average,	**10.60**	**10.92**	**3.90**	
	Rye and Oats.				
198	Rye and oats,	9.61	11.13	4.49	Contains yellow corn.
163	Rye and oats chop, one-half each,	10.22	10.31	2.53	
184	Rye and oats,	9.22	9.63	2.8[illegible]	
178	Rye and oats,	10.22	13.63	3.[illegible]	Chiefly middlings with a little oats.
11	Rye and oats,	9.42	10.44	3.[illegible]	Hulls abundant.
	Range,	9.22-10.22	9.63-13.63	2.53-4.49	
	Average,	**9.74**	**11.03**	**3.24**	
	Rye and Corn.				
49	Corn and rye,	11.19	11.31	3.28	Rye middlings and yellow corn.
38	Mixed feed (rye and corn),	....	8.81	3.60	Contains little rye bran.
37	Mixed feed for horses (rye middlings and corn),	10.[illegible]	10.44	3.52	Considerable bran present.
	Range,	10.[illegible]-11.19	8.81-11.31	3.28-3.60	
	Average,	**10.97**	**10.19**	**3.47**	

Number.	Description.	Moisture, per cent.	Protein, per cent.	Fat, per cent.	Remarks.
	Corn, Oats and Rye.				
272	Corn and oats and rye,	10.51	10.00	3.01	
170	Rye, corn and oats chop,	9.70	10.88	4.99	Proportion of oats small.
194	Rye, corn and oats chop,	9.16	11.56	2.92	Proportion of oats small.
52	Corn, rye and oats,	10.81	9.13	2.78	Rye predominant.
63	Corn, oats and rye chop,	9.57	9.00	3.55	Some cob present.
160	Rye mixed chop,	9.27	11.13	3.33	Large proportion of oats.
182	Rye, corn and oats chop,	9.42	9.38	3.42	Small proportion of corn.
65	Corn, oats and rye chop,	11.12	9.13	3.40	Proportion of hulls large.
36	Mixed feed No. 1, rye, corn and oats,	10.45	9.31	3.12	
	Range,	9.16-11.12	9.00-11.56	2.78-4.99	
	Average,	**10.00**	**9.95**	**3.40**	
	Corn-and-Cob Meal, Oats and Rye.				
39	Ear corn, rye and oats,	9.48	8.94	3.27	Particles of cob not abnormal in quantity.
	Corn, Oats and Barley.				
21	Corn, oats and barley,	7.30	10.63	4.37	
68	Corn, oats and barley,	8.07	10.31	4.76	
26	Corn, oats and barley,	11.09	7.38	2.96	Large proportion of hulls.
	Range,	7.30-11.09	7.38-10.63	2.96-4.76	
	Average,	**8.82**	**9.44**	**4.03**	
	Corn, Oats and Wheat.				
122	Corn, oats and bran feed,	9.89	9.13	3.55	Some cob present; oat hulls abundant; bran not prominent.
	H. O. Feeds.				
85	H. O. dairy feed,	8.93	16.56	3.22	Oat hulls prominent; corn, wheat and cotton-seed meal.
112	H. O. dairy feed,	9.39	16.88	3.55	
	Average,	**9.16**	**16.72**	**3.39**	
84	H. O. horse feed,	9.78	11.06	3.53	Oat hulls prominent; cracked corn, wheat middlings and a little linseed meal.
115	H. O. horse feed,	9.08	10.88	2.99	
	Average,	**9.43**	**10.97**	**3.26**	
14	Sucrene dairy feed,	9.33	14.00	2.43	Reducing sugars, 6.31 per cent. roasted corn, oat hulls and linseed detected.

Assuming that the mixtures named should be made up from the unseparated products from the milling of the whole grains, that the grains are of average composition and that they enter in equal proportion into the mixtures, their percentage composition would be as follows:

Mixture.	Moisture.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Wheat and oats,	10.7	2.4	11.8	5.7	65.8	3.6
Wheat and corn,	10.5	1.7	11.1	2 0	71.1	3.6
Rye and oats,	11.3	2.4	11.2	5.6	66.1	3.4
Rye and corn,	11.1	1.7	10.4	2.0	71.4	3.4
Corn, oats and rye,	11.1	2.1	10.9	4.5	67.5	3.9
Corn-and-cob meal, oats and rye,	12.6	2.1	10.3	5.9	65.7	3.4
Corn, oats and barley,	10.8	2.3	11.5	4.8	66.7	3.9
Corn, oats and wheat,	10.7	2.1	11.3	4.5	67.4	4.0
Corn, oats and wheat bran,	11.2	3.4	12.5	6.9	61.3	4.7

Variations in the proportions of the several grains will produce some variation in the products, but it is interesting to observe how slight the differences are between the percentages of protein and fat in the foregoing mixtures.

Comparison of the data presented in the foregoing table and the analytical results from the examination of the mixed stock feeds will at once reveal many cases of abnormal composition, due in a large proportion of cases to the use of oat hulls as an admixture; in some instances, to the presence of corn in great excess over the other grains named.

Most of the samples examined represent goods made solely for local use; a few are sold in many States:

Quaker Dairy Feed, made by the American Cereal Co., of Chicago, is composed of wheat and oats products; no guaranty accompanied the sample, but in New York and New England it is guaranteed to contain 12.03 per cent. of protein and 2.5 per cent. of fat; the Connecticut Bulletin 133 gives the results of 28 recent analyses as 13.53 per cent. protein and 3.13 per cent. fat. The samples analyzed here show a considerably inferior composition. The makers of sample No. 10 are not reported; it differs from the others in containing considerable quantities of white corn, its protein being decreased and its fat increased as a result.

Corn, Oats and Barley also made by the American Cereal Company, is represented by samples Nos. 21 and 68. No guaranty of composition accompanied them. The average of six recent New England analyses gives 11.9 per cent. of protein and 4.5 per cent. of fat. The Pennsylvania samples are considerably inferior.

Sample 26, of the same name, but reported as made by the Toledo Milling Company, is very far inferior, containing a very large proportion of hulls.

H. O. Dairy Feed, made by the H. O. Company of Buffalo, and composed of oat hulls with corn, wheat and cotton-seed meal, is represented by samples 85 and 112. It is guaranteed to contain 18.46 per cent. of protein and 4.53 per cent. of fat. The average of nine recent New England analyses is 18.06 per cent. of protein and 4.01 per cent. of fat. The Pennsylvania samples are far inferior.

H. O. Horse Feed, made by the same company, and containing a little linseed instead of cotton seed meal, is guaranteed to contain 12.42 per cent. of protein and 4.54 per cent. of fat. The average of 18 recent New England analyses is 12.4 per cent. of protein and 4.2 per cent. of fat. Again, Pennsylvania samples are inferior.

Sucrene Dairy Feed, reported as made by Brook and Pennock, of Philadelphia, is accompanied by no guaranty. Its chief proteid ingredient is linseed meal; by roasting, the other substances contained have been darkened; a considerable proportion of reducing sugars is present. An analysis made by the Massachusetts Station (B. 64, p. 22), shows 18.69 per cent. protein and 2.97 per cent. fat.

SPECIAL POULTRY FOODS.

A number of "poultry foods" were examined:

No.	Manufacturer.	Dealer.	Price per ton.
89	Simpson Bros., Norristown,	Simpson Bros.,	$26 00
131	Bennett & Millett, Gouverneur, N. Y.,	Snyder Bros., Dalton,	40 00
138	Smith & Romain, New York,	Snyder Bros.,	25 00
142	American Cereal Co., Chicago, Ill.,	Snyder Bros.,	25 00
148	(Shipped from Philadelphia),	Snyder Bros.,	17 00

The descriptions and analyses of these foods are as follows:

No.	Description.	Moisture.	Protein.	Fat.
89	Superior poultry food,	11.00	13.50	4.15
131	Clover meal for poultry,	9.27	6.38	2.00
138	Boiled beef and bone for poultry,	5.81	42.63	17.97
142*	American poultry food,	9.45	11.75	4.93
148	Rice feed for poultry,	8.55	10.94	9.28

* Said to be composed of corn, oats, wheat and barley.

Microscopic examination indicates that No. 89, Simpson's Poultry Food, is a mixture of middlings, oats and corn; the proportion of hulls seems rather excessive.

No. 131, "Clover Meal," appears to be very fine-cut clover hay.

No. 138 shows nothing foreign to the name.

No. 142, composed, as classified, of oats, corn, wheat and barley.

No. 148 composed chiefly of rice hulls and polish.

Of these goods, several are worthy of further remark: The price of No. 131, even after the most extreme allowance for the expense of retailing in small quantities, is altogether out of proportion to the food value. Clover hay has an average of 12.3 per cent. protein, sometimes rising to 20.9 per cent., and an average of 3.3 per cent. of crude fat or ether-extract, sometimes reaching 5.9 per cent. The shatterings, commonly used on the farm as a poultry food, are still richer in protein. A Connecticut analysis gives for this poultry food, 9.5 per cent. protein and 2.42 per cent. fat, a much higher value.

The proportion of fat in the rice feed, No. 148, is unusually high, otherwise the composition is normal; the range of composition for the more important rice by-products, obtained by the investigations of a number of the Southern experiment stations is:

	Protein, per cent.	Fat, per cent.
Rice bran,	10.9-13.6	5.2-10.9
Rice hulls,	2.9-4.7	0.6-0.9
Rice polish,	[illegible]	[illegible]

A large proportion of the food is evidently derived from the polish.

American Poultry Food, represented by sample No. 142, is on sale in other States and has been guaranteed in New York State to contain 13.65 per cent. of protein and 3.96 per cent. of fat. The average of nine recent analyses in States having food controls shows 13.20 per cent. of protein and 6.20 per cent. of fat. The Pennsylvania sample is conspicuously inferior.

CONDIMENTAL FOODS.

Two samples of foods of this class were received:

No.	Manufacturer.	Dealer.	Price per ton.
87	Simpson Bros., Norristown, Pa.,	Simpson Bros.,	$160 00
[illegible]	John W. Barwell, Waukegan, Ill.,	F. L. Heath, Corry, Pa.,	70 00

No. 87, Simpson Bros'. Condimental Stock Food is stated by them to have given good satisfaction in general use in their locality. The percentage composition, in terms of the ordinay food analysis, is as follows:

	Per cent.
Moisture,	13.50
Ash,	16.96
Protein,	7.25
Fiber,	9.38
Nitrogen-free extract,	50.41
Fat,	2.50
	100.00

The composition of the ash is such as to indicate the presence of 4.91 per cent. of common salt and about 13.28 per cent. of Epsom salts; a very considerable amount of iron is also present, probably in the form of oxid.

Microscopical examination indicates that the principal vegetable material present is the hulls, glumes, palets and a portion of the cob of corn, together with some starch; bits of charred matter also appear. The material has a slightly defined aromatic odor.

No. 254, Blatchford's Calf Meal, has been frequently examined. It is claimed to be "The Perfect Milk Substitute," but the directions show that it is to be used in connection with the other foods commonly given to calves at their several stages of growth. It is claimed to be chiefly composed of the "carob" or "locust bean" meal with leguminous seeds, such as the lentil, and oleaginous seeds, such as flax seed, and to contain no cheap mill feeds.

On analysis, the following results were obtained:

	Per cent.
Moisture,	7.20
Protein,	23.94
Fat,	4.70

The average of six recent analyses (Connecticut Station, Bulletin 133, page 28) shows 24.45 per cent. protein and 4.62 per cent. fat.

The carob bean has recently been investigated by the Connecticut Station (B. 130, p. 21). In 100 parts of the pod fruit there are 7.5 per cent. of seeds and 92.5 per cent. of empty husk or pod. The percentage composition of the several parts and of the whole is:

	Seeds.	Husks.	Full pod.
Mosture,	12.84	14.15	14.05
Ash,	3.27	3.25	3.26
Protein,	15.00	4.81	5.57
Fiber,	7.16	4.80	4.98
Nitrogen-free extract,	59.90	72.77	71.80
Fat,	1.83	.22	.34
	100.00	100.00	100.00

These figures agree with European analyses.

The composition of the "calf meal" and the carob bean are too different, therefore, to make it possible for the latter to constitute the greater part of the former. Dr. A. L. Winton, of the Connecticut Station, found linseed meal to be the chief constituent, and beside the carob bean, there were also present cotton-seed meal, a wheat product and fenugreek. These findings agree essentially with those of our microscopic examination of sample No. 254.

Composition of Other Condimental Foods.

Within the past year or two, extensive examinations, chemical and microscopical, have been made of the more commonly sold condimental foods. This work has been especially taken up by the Connecticut and Massachusetts Experiment Stations, though others have added work of value.

Owing to the prevalence of this class of goods in this State, it has been thought of interest to present in compendious form, the results of these investigations. The food analyses, made for the purpose of determining the proportions in which the ordinary food constituents are present, will be grouped in tabular form. The results of microscopical and special chemical examinations will be separately presented. The prices per ton affixed are calculated from the pound prices at which the goods are retailed; doubtless these rates could be greatly reduced in wholesale transactions in these several trade articles, but owing to the large claims commonly advanced as to the nutritive effect of these materials when consumed in small quantities, the comparison of prices by the method adopted is not an unfair one.

American Cattle Feeding Salts, made by the American Cattle Feeding Salts Co., 138-140 55th street, New York city, John M. Draper, Agricultural and Research Chemist, Manager. Price not stated. Claimed to consist of "various tonic substances and natural salts," which when added to other feeds is a means of growing prime beef, brighter in color, wavy or marbled in texture, and with pure white fat, in much less time than under the present system of feeding." Analysis by the Connecticut Station shows:

	Per cent.
Common salt,	16.0
Glauber's salts,	63.5
Epsom salts,	4.8
Carbonate of soda,	9.3
Matter insoluble in water,	1.5
Water and other volatile matter,	4.9
	100.0

American Spice Food, made by the American Spiced Food Co., Boston. Price not stated. Found by the Massachusetts Station (B. 71, pp. 28-9) to consist chiefly of corn with an addition of pepper.

American Triumph Horse and Cattle Food, made by McKenzie and Winslow, Fall River, Mass. Price $200 per ton. According to the Massachusetts Station (Bulletin 71, p. 28) it is chiefly composed of corn, barley and some material rich in protein, with some charcoal and an aromatic substance like fenugreek.

American Triumph Poultry Food, made by the same firm. Price $200 per ton. According to the Massachusetts Station (*Loc. cit.*) it is chiefly composed of rye, corn, barley and some material rich in protein, together with pepper and an aromatic like fenugreek.

Anglo-American Food for Stock made by the Anglo-American Mfg. Co., Boston. Price $360 per ton. Food analysis made by the New York Experiment Station (Bulletin No. 267), but no report made upon the nature of the ingredients.

Anglo-American Poultry Food made by the same company. Price not stated. According to the Massachusetts Station (B. 71, p. 30) it is chiefly composed of wheat and rye brans, together with corn, some materials rich in protein, charcoal and pepper.

Bnner Poultry Food, made by the Banner Food Co., Auburn, N. Y. Price $200 per ton. According to the Massachusetts Station (*Loc. cit*) it is chiefly composed of linseed meal and wheat offals, together with some salt, charcoal and phosphate of lime.

Banner Stock Food, made by the same company. Price not stated. Is composed, according to the Massachusetts Station, chiefly of linseed meal, together with wheat offals, oats, charcoal, salt and sulfates, probably in the form of Glauber's salts.

Barwe'lls Horse and Cattle Food, made by John W. Barwell, Waukegan, Ill. Price $120 per ton. Is chiefly composed of linseed meal with, perhaps, some flaxseed meal and other ingredients not determined (Massachusetts Station).

Baum's Poultry Food, made by Baum's Castorine Company, Syracuse, N. Y. Price $250 per ton. According to the Connecticut Sta-

tion (B. 132, p. 5) this is composed of linseed meal, wheat feed, cayenne pepper, charcoal, salt, Epsom salts, iron oxid and sulfur; the latter is present in the "crude fat" to the amount of 6.73 per cent. of the entire material. The salt amounts to 5 per cent. approximately.

Baum's Stock Food, made by the same company. Price $180 to $200 per ton. According to the Connecticut Station (*Loc. cit.*) it is composed of linseed meal, charcoal, salt, Epsom salts and sulfur; the same finding was made by the Massachusetts Station. There is 3.5 per cent. of salt and about 4 per cent. of free sulfur present, with probably 3 per cent. of Epsom salts.

Benjamin's Food for Horses and Cattle, made by Benjamin's Food Co., Danbury, Conn. Price $250 per ton. Composed of linseed meal, wheat feed and fenugreek (Conn. Sta., B. 132, p. 5).

Benjamin's Poultry Food, made by the same company. Price $250 per ton. According to the Connecticut Station, it is composed of linseed meal, wheat feed, corn meal, cotton-seed meal and mustard hulls.

Champion Horse and Cattle Food made by the Champion Food Co. Price $300 per ton. Chiefly composed of corn, with linseed, rice, charcoal, salt and sulfates, probably Glauber's salts.

Climax Stock Food, made by L. B. Lord, Burlington, Vt. Price $210 per ton. Composed, according to the Massachusetts Station, chiefly of wheat and barley, together with salts and copperas. The New York Station found in one sample a very large quantity of sulfur, constituting most of the ether-extract.

Colonial Poultry Food, made by the Puritan Mfg. Co., Rochester, N. Y. Price not stated. Composed chiefly of barley and other cereals, charcoal, salt and pepper. (Mass. Sta., B. 71, p. 30.)

Colonial Stock Food, made by the same company. Price $200 to $275 per ton. Composed, according to the Massachusetts Station, of wheat, a large amount of charcoal, salt and a condiment resembling fenugreek.

Dow's Poultry Meal, made by J. C. Dow, Boston. Price $300 per ton. Composed, according to the Massachusetts Station, of meat, bone, salt and oyster shells.

Eggine, made by the Eggine Co., Hartford, Conn. Price not stated. Composed, according to the Massachusetts Station, chiefly of fine ground oyster shells, with animal matter, pepper, charcoal and Epsom salts.

Eureka Egg Food, Jos. Breck's Sons Corporation, Boston, Mass. Price not stated. Composed of cereals, highly proteid material, charcoal, salt and oyster shells (Mass. Sta., B. 71, p. 30).

Flagg's Poultry Food. Price $240 per ton. Composed, according to the Massachusetts Station, of corn, wheat offal, pepper, salt, charcoal, Epsom salts and Venetian red.

Flower City Horse and Cattle Food. Maker and price not stated. No details given as to the nature of the ingredients.

Dr. Hess's Poultry Panacea, made by Dr. Hess and Clark, Ashland, O. Price $340 per ton. Composed, according to the Connecticut Station, of wheat feed, charcoal, salt, carbonate of lime and iron oxid (Venetian red); nearly 12 per cent. of salt is found present. The Massachusetts Station reports the presence of barley and Epsom salts in addition.

Dr. Hess's Stock Food, made by the same firm. Price $140 per ton. According to the Massachusetts Station, it consists chiefly of bran, together with a material high in protein, charcoal, salt, iron, Glauber's salts, and a condiment resembling fenugreek.

Ideal Egg Food, made by the Poultry Supply Co., Boston. Price not stated. Composition, according to the Massachusetts Station, chiefly of cereals, with material high in protein, pepper, charcoal, iron, carbonate of lime and Glauber's salts.

International Poultry Food, made by the International Food Co., Minneapolis. Price $250 per ton. Examination at the Connecticut Station shows it to be composed of wheat feed, cayenne pepper, a bitter drug, charcoal and salt, about 2.25 per cent.

International Stock Food, made by the same company. Price $250 to $400 per ton. Composed, according to the Connecticut Station, of wheat feed, cayenne pepper, charcoal, salt (8.38 per cent.) and a bitter drug resembling gentian. This finding is, in the main, confirmed by the Massachusetts Station.

Jersey Tonic and Condition Powder, made by H. A. Esterbrook, Fitchburg, Mass. Price $360 per ton. Composed of wheat offal, ground herbs, pepper, Glauber's salts and Venetian red. (Mass. Sta., B. 71, p. 30.)

Knight's English Vegetable Food, made by Knight's Stock and Poultry Food Co. Price $140 per ton. Composition, chiefly wheat offal, with rye, corn, charcoal, salt and a condiment resembling fenugreek. (Mass. Sta., B. 71, p. 30.)

Knight's Poultry Food, made by the same company. Price $200 per ton. Composed chiefly of bran, with corn, some material rich in protein, salt, sand and an aromatic resembling fennel.

Lightning Horse, Cattle and Poultry Powders, made by the Herb Medicine Co., Springfield, O. Price $400 per ton. Analyzed by Virginia Station (B. 107, p. 232); no statement is made concerning the ingredients save that the ether-extract is chiefly composed of sulfur.

McClaren's English Horse Food, made by McClaren, Brockton, Mass. Price not stated. Composed chiefly of corn, oats, wheat, rice and a bitter substance resembling gentian. (Mass. Sta., B. 71, p. 28.)

Magic Poultry Food and Egg Producer, made by Magic Food Co., Chattanooga and St. Louis. Price $250 per ton. Analysis by Virginia Station without details as to the nature of the ingredients.

Magic Stock Food (Mansfield), made by the same company. Price $250 per ton. Analysis as in case of the previous food.

Chas. Marvin Stock Food, manufacturer not named. Price $1,000 per ton. Ordinary food analysis made by the New York Station without detail as to the nature of the ingredients. (B. 166, p. 267.)

Matthews Compound Food, made by Eastman Bros., Framingham, Mass. Price not stated. Chiefly composed of cereals with the addition of linseed meal and salt. (Mass. Sta., B. 71, p. 28.)

Medicated Meal, made by F. C. Sturtevant, Hartford, Conn. Price $400 per ton. Composed of linseed meal, corn meal, ginger, fenugreek, a bitter drug and sulfur (about 3 per cent.) (Conn. Sta., B. 132, p. 5.)

Myers' Royal Horse and Cattle Spice, Myers', Niagara Falls, N. Y. Price $200 to $250 per ton. Composed, according to the Connecticut Station, of linseed meal, corn meal, wheat feed, malt sprouts, mustard hulls, turmeric, cocoa shells, salt and fenugreek. The Massachusetts Station indicates the additional presence of rice, oat and bean meals; the salt amounts to 16.5 per cent.

Myers' Royal Poultry Spice, made by the same firm. Price $300 to $350 per ton. Composition, according to the Connecticut Station, like the foregoing with the omission of the malt sprouts and the addition of cayenne. The Massachusetts Station reports the presence of rape seed. The salt, in the sample examined by the Connecticut Station, amounts to nearly 13 per cent.

Nutriotone, made by the Thorley Food Co., Chicago. Price $320 to $500 per ton. This is one of the older condimental foods on the market and has been frequently examined. A recent examination by the Connecticut Station shows the presence of linseed and cottonseed meals, corn meal, wheat feed, salt (13.10 per cent.), charcoal, sulfur (.83 per cent.) and fenugreek. The Massachuetts Station reports the presence of bean meal.

Orange Electric Food, made by G. E. Vincent, Catskill, N. Y. Price $340 per ton. Composed of corn and linseed meals, charcoal and sulfur (.4 per cent.) (Conn. Sta., B, 132, p. 5.)

Pratt's Animal Regulator, made by the Pratt Food Co., Phila., Pa. Price $320 to $500. Composed, according to the Connecticut Station, of corn meal, salt (10.11 per cent.), charcoal, fenugreek and a bitter substance resembling gentian. The Massachusetts Station reports the presence, in addition, of fennel and Glauber's salts.

Pratt's Horse and Cattle Food, made by the same firm. Price $146.67 per ton. Composed chiefly of cereals and beans with fennel. (Mass. Sta., B. 71, p. 28.)

Pratt's Poultry Food, made by the same company. Price $240 to $320 per ton. The Connecticut Station found the following ingredients, corn meal, wheat feed, iron oxid, sulfur (.81 per cent.), and a bitter drug. The Massachusetts Station reports upon one sample in about the same terms with the addition of cayenne, but upon another as composed of corn, bean and rice meals, pepper, Venetian red and fenugreek.

Prolific Poultry Food, made by L. B. Lord, Burlington, Vt. Price not stated. Composed of animal matter, linseed husks, charcoal, sand, salt, Epsom salts and carbonate and phosphate of lime. (Mass. Station.)

Rochester Horse and Cattle Food, made by the Rochester Horse and Cattle Food Co., Rochester, N. Y. Price $500 per ton, pound package price; $170 in 200 pound lots. The Pennsylvania Station (Rep. 1899, p. 172) found it to contain wheat offal, some richly proteid material, salts, charcoal, an aromatic and a bitter substance.

Royal Stock Food, name of maker not stated. Price $125 per ton. Food analysis without detail as to ingredients by the New York Station.

Rust's Egg Producer, made by Wm. Rust & Sons, New Brunswick, N. J. Price $500 per ton. Chiefly composed of shells and charcoal, together with some material rich in protein and pepper. (Mass. Station.)

Sheridan's Condition Powder, made by I. S. Johnson & Co., Boston. Price $2,000 per ton. Composed of linseed, cellular matter, ginger, pepper, charcoal, carbonate and phosphate of lime and Epsom salts. (Mass. Station.)

Stanley's Condition Powder, made by J. J. Stanley, Lawrence, Mass. Price $120 per ton. Composed chiefly of wheat and corn with salt and fenugreek. (Mass. Station.)

Thorley's Horse and Cattle Food, made by The Thorley Food Co., Chicago, Ill. Price not stated. Chiefly composed of rice and linseed, with beans, salt and fenugreek. (Mass. Station.)

Triplex Poultry Food, made by the Triplex Food Co., New Brunswick, N. J. Price $240 to $340 per ton. Composed of linseed meal, wheat feed, charcoal, ground bone, lime carbonate, iron oxid and sulfur (nearly 1 per cent.) (Conn. Station.) The Massachusetts Station finds, in addition, corn, pepper and Glauber's salts.

Triplex Stock Food, made by the same company. Price not stated. Food analysis, without detail as to ingredients, by the New York Station.

Weston's Condition Powder, made by J. W. Weston, New York city. Price $320 per ton. Composed of wheat, corn, bean and linseed meals, with fenugreek. (Mass. Station.)

White's Stock Food, made by the White Food Co., Taunton, Mass. Composed chiefly of bran with an admixture of fenugreek. (Mass. Station.)

Wilbur's Egg Food, made by Wilbur's Seed Meal Co., Milwaukee, Wis. Price $222 per ton. Analysis without description of ingredients by the Virginia Station.

Wilbur's Seed Meal, made by the same company. Price not stated. Analysis without statement of ingredients by the New York Station.

The results of the food analyses of the foregoing foods, together with an indication of the number of analyses upon which the statement is based and the sources from which they are drawn, are given in the following table. It should be borne in mind that the presence of mineral drugs in the condimental foods leads to some variation in the composition of the several groups of materials separated by the common analytical processes; thus, the free sulfur appears with the fat, the charcoal with the fiber, and, since the nitrogen-free extract is computed by subtracting the sum of the other groups from 100, it represents, in cases where large quantities of oyster shell have been admixed, not only sugar, starch and the usual constituents but also so much of the carbonic acid as is driven off from the shells in making the ash determination.

In this connection, it may be noted that the analyses of different Stations and even analyses of different packages by the same Station, show a tendency to very little uniformity of composition in most of these foods and point, in some cases, to a change of formula at convenience.

Food Analyses of Condimental Foods (per cent.).

Name.	Number of analyses.*	Moisture.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
American Spiced Food, ...	1m	10.41	2.28	12.81	2.90	67.70	3.91
American Triumph Horse and Cattle Food, ...	1m	10.94	6.95	14.94	8.96	53.21	5.00
American Triumph Poultry Food,	1m	9.14	5.54	15.22	9.79	54.76	5.56
Anglo-American Food for Stock,	1n	7.20	13.28	15.50	7.86	25.80	4.85
Anglo-American Poultry Food,..	1m	7.99	5.33	16.06	8.70	56.59	5.33
Banner Poultry Food, ...	1m	8.78	11.29	19.94	12.37	41.12	6.50
Banner Stock Food, ...	1m	8.88	9.35	23.56	15.24	38.01	4.96
Barwell's Horse and Cattle Food,	1m	7.52	6.41	20.72	5.16	50.47	9.72
Baum's Poultry Food, ...	1c	6.95	16.68	19.53	15.40	32.62	8.82
Baum's Stock Food, ...	3cmn	9.07	9.68	26.52	16.47	30.79	7.47
Benjamin's Food for Horses and Cattle, ...	1c	6.92	5.52	27.82	7.57	45.92	6.25
Benjamin's Poultry Food, ...	1c	7.05	5.42	29.19	8.44	42.92	6.98
Champion Horse and Cattle Food,	2mn	9.55	12.52	11.72	4.18	57.43	4.60
Climax Stock Food, ...	2mn	8.72	18.09	9.99	4.42	38.06	20.72

Name.	Number of analyses.	Moisture.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Colonial Poultry Food, ...	1m	9.71	6.85	10.00	4.84	65.82	2.78
Colonial Stock Food, ...	2mn	8.97	11.04	10.46	10.45	56.27	2.81
Dow's Poultry Meal, ...	1m	20.22	36.75	30.50	2.06	....	2.02
Eggine, ...	1m	.73	58.74	3.06	14.78	20.75	1.94
Eureka Egg Food, ...	1m	5.98	20.79	16.50	7.78	44.34	4.61
Flagg's Poultry Food, ...	1m	8.31	9.14	13.97	5.85	58.92	3.78
Flower City Horse and Cattle Food, ...	1n	9.27	11.29	14.37	9.70	50.25	5.12
Dr. Hess's Poultry Panacea, ...	3cm	8.22	29.00	11.65	4.86	44.36	1.91
Dr. Hess's Stock Food, ...	1m	7.82	13.08	16.19	7.11	52.55	3.25
Ideal Egg Food, ...	1m	8.02	13.98	18.50	9.19	45.49	4.82
International Poultry Food, ...	1m	6.79	7.87	14.88	13.97	49.69	6.80
International Stock Food, ...	3cmn	7.78	10.05	15.05	9.61	50.20	7.31
Jersey Tonic and Condition Powder, ...	1m	11.41	11.98	14.07	7.31	52.04	3.19
Knight's English Vegetable Food, ...	1m	8.59	12.69	15.25	7.47	51.47	4.53
Knight's Poultry Food, ...	1m	7.27	22.82	14.69	7.21	44.29	3.72
Lightning Horse, Cattle and Poultry Powders, ...	1v	11.15	3.05	17.44	2.70	38.48	26.18
McClaren's English Horse Food,.	1m	11.05	5.83	10.38	1.43	67.96	3.35
Magic Poultry Food and Egg Producer, ...	1v	2.67	18.03	11.19	18.81	44.85	4.45
Magic Stock Food, ...	1v	8.10	5.39	11.00	22.45	47.82	5.24
Chas. Marvin Stock Food, ...	1n	8.26	5.97	30.94	10.63	39.92	4.28
Matthew's Compound Food, ...	1m	10.88	10.98	15.38	3.34	54.39	5.03
Medicated Meal, ...	1c	6.34	8.94	24.10	10.98	39.08	10.56
Myer's Royal Horse and Cattle Spice, ...	3cm	9.11	13.11	17.32	5.85	50.90	3 71
Myer's Royal Poultry Spice, ...	2cm	8.28	11.64	16.50	7.14	51.56	4.88
Nutriotone, ...	3cmn	7.56	18.17	20.19	5.09	43.52	5.4
Orange Electric Food, ...	1c	6.80	4.00	15.03	7.21	58.92	7.44
Pratt's Animal Regulator, ...	2cm	7.89	11.70	9.91	3.23	62.80	4.4
Pratt's Horse and Cattle Food,...	2mm	8.29	5.82	14.97	6.21	57.50	7.21
Pratt's Poultry Food, ...	3cm	8.35	6.70	14.78	6.22	56.26	7.69
Prolific Poultry Food, ...	1m	8.39	23.99	20.19	9.21	31.67	6.55
Rochester Horse and Cattle Food,	2np	8.40	9.74	16.32	11.70	47.74	6.10
Royal Stock Food, ...	1n	5.56	44.07	11.25	9.73	25.87	3.52
Rust's Egg Producer, ...	1m	4.56	52.51	19.31	6.52	13.57	3.53
Sheridan's Condition Powder, ...	2m	7.57	16.50	16.00	15.07	30.62	14.24
Stanley's Condition Powder, ...	1m	9.35	5.46	13.13	5.83	61.91	4.32
Thorley's Horse and Cattle Food,	1m	10.55	9.92	19.19	9.80	41.73	5.81
Triplex Poultry Food, ...	2cm	5.72	39.80	18.17	5.27	26.53	4.51
Triplex Stock Food, ...	1n	7.10	12.05	15.31	6.31	53.57	5.66
Weston's Condition Powder, ...	1m	9.31	5.09	15.63	5.00	59.27	4.70
White's Stock Food, ...	1m	10.21	5.79	15.81	10.44	52.33	5.42
Wilbur's Egg Food, ...	1v	7.72	10.14	18.43	13.23	46.26	4.22
Wilbur's Seed Meal, ...	1n	7.13	12.16	20.00	8.18	46.90	5.63

*c, Connecticut Station; m, Massachusetts Station; n, New York (Geneva) Station; p, Pennsylvania; v, Virginia Station.

The most striking feature about these materials is their enormous cost to the purchaser, $100 to $2,000 per ton. Their direct cost to the manufacturer is quite another matter. Their major proportion by weight is composed of ordinary feeding stuffs, costing at retail from $15 to $40 per ton. In a few cases, especially of so-called "egg-foods," they are more largely composed of oyster shells, whose market value is certainly much less. The other ingredients that enter into their composition in at all important quantities are bone, charcoal, flowers of sulfur, common salt, Glauber's salts, Epsom salts and Venetian red; while there are also added certain spicing, aromatic or bitter substances in small quantity.

The wholesale prices of some of the less common materials, as given by the *Oil, Paint and Drug Reporter* of New York, for July 8, 1901, are:

	Cents per pound.
Epsom salts,	.9 to 1.25
Flowers of sulfur,	1.85 to 2.05
Venetian red,	1.8 to 3.0
Ginger root,	4 to 4.25
Anise seed,	7.75 to 8.5
Fenugreek,	2.0 to 2.25
Fennel seed,	5.0 to 6.0

There is therefore no reason in the cost of the ingredients for the very great charges made for these mixtures.

In the second place, it is evident that the makers use much the same range of ingredients but select individual materials and proportions differently. The one common characteristic is the claim each makes, first, for the great nutritive value of very small quantities of his article of manufacture, and in most cases, second, for its medicinal value for a wide range of diverse ailments. Clearly, since exact selection of material and proportion is of so little importance, any reader of this paragraph can make a "condition powder" for his own stock with as good prospect of valuable results and at a very great saving of cost.

But as to the value of such condimental and semi-medicinal preparations: First, as used for healthy animals. Any direct nutritive value they possess is due to the common feeding stuffs they contain, but the quantities fed are too insignificant to cause considerable gains in production. Any indirect value they may have must be due to some economy of the other foods with which they are always directed to be fed, such economy being in the way of increased digestion of the food or its better utilization by the animal after digestion. A number of careful experiments have been made to determine the fact of such effect from condimental foods, but in not a single instance is there evidence of any economic action of the kind.

As to their supposed medicinal action: The ingredients commonly found have different effects. Some are used in veterinary practice as stomachics, stimulating the coatings of the stomach and bowels—anise seed, cayenne pepper and black or white pepper in doses of 2 drachms, fennel seed in doses of 1 drachm and ginger root in doses of 1 oz. Stomachics are employed in cases of pronounced indigestion; the doses are not expected to be given except on rare occasions. Charcoal is useful to reduce accumulations of gas; for this purpose considerable doses must be administered.

Epsom and Glauber's salts are used as purgatives; the former in

doses of 1 to 2 pounds act as a laxative for the ox, the latter in doses of 1½ pounds as a purgative for the horse. Sulfur, also, in doses of 1 oz. acts as a laxative; in doses of 3 to 4 oz. the latter acts to stimulate the perspiratory glands.

Gentian is frequently used as a bitter tonic, with decided laxative and stomachic effects; and iron oxid is also employed as a tonic.

So far as the stomachics are concerned, those of the usual condimental foods are often of the least efficient character, such as fenugreek, which is not often included in modern lists of *materia medica*.

The quantities of the condimental foods necessary to be fed to give the usual medicinal dose of any one of the medicinal ingredients are very large. Especially should it be urged that a sick animal needs specific treatment for its particular ailment. That beneficial results are sometimes found to attend the use of condimental foods is admitted, but the benefit is gained at an unnecessary cost and is rather accidental than the logical result of a discriminating treatment.

The increased appetite often observed to follow the use of such foods, might often be secured by any change of diet, especially by the proper use of salt. Mild laxative effects are better secured by green food and a proper use of mashes in the diet. If tonic effects are desired, use the known materials for producing such effects and in the requisite quantities. See that fowls have the necessary access to cracked bone or oyster shells to furnish the egg shell materials.

In view of their great cost, of their comparatively small direct nutritive value, their lack of indirect nutritive value, their weakness and uncertain fitness as medicinal agents, the use of such commercial mixtures seems entirely unwarranted.

RELATIVE COST OF FEEDING STUFFS AS SOURCES OF PROTEIN.

In the introductory paragraphs of this bulletin it has been noted that the principal purpose in the introduction of the commercial feeding-stuffs upon the farm is to secure an increased proportion of protein in the farm rations. It will be of interest therefore to compare the expenditure required in purchasing some convenient unit quantity, say 20 pounds, of this nutrient in the various classes of commercial feeds.

This method of comparison is further justified by reason of the fact that protein is usually the chief variable among the several groups of food constituents present. On the other hand, it would be evidently incorrect to charge the protein with the entire cost of the feeding-stuff, the major portion of which is composed of other materials of some value.

Commercial Feeding Stuffs Arranged According to Their Percentage of Protein.

	Protein.	Fat.	Cost per ton.	Expenditure in buying 20 pounds of protein.
Cottonseed meal,	44.40	10.10	$27.50	0.619
Linseed meal, new process,	34.25	2.63	27.67	0.808
Linseed meal, old process,	34.10	6.04	28.56	0.838
Buckwheat middlings,*	31.06	8.77	18.00	0.580
Gluten feed,	24.72	2.84	18.33	0.741
Malt sprouts,	22.96	1.61	16.17	0.704
Germ oil cake,*	22.56	9.77	22.50	0.997
Red dog flour,	19.14	4.87	19.44	1.016
H. O. dairy feed,	16.72	3.39	21.25	1.271
Wheat shorts,	16.52	5.18	19.33	1.170
Buckeye wheat feed,*	16.50	4.53	20.00	1.212
Wheat middlings,	16.05	4 60	19.31	1.203
Wheat bran,	15.30	4.48	18.85	1.232
Wheat feeds,	14.21	3 90	19.33	1.360
Sucrene dairy feed,	14.00	2.43	18.50	1.321
Sugar corn feed,*	12.81	2.72	14.00	1.093
Wheat and oats feed,	12.23	4.15	18.00	1.472
Rye and oats feed,	11.03	3.24	21.00	1.904
H. O. horse feed,	10.97	3.26	21.25	1.937
Quaker dairy feed,	10.94	2.88	18.00	1.828
Wheat and corn feeds,	10.92	3.90	18.00	1.645
Cerealine feeds,	10.84	8.68	18.00	1.660
Corn bran,	10.75	10.37	17.33	1.612
Hominy chop,	10.75	8.59	18.50	1.721
Corn, oats and barley (American Cereal Co).,	10.47	4.57	20.00	1.911
Rye chop,	10.29	1.77	26.00	2.527
Rye and corn,	10.19	2.47	20.67	2.028
Corn, oats and rye,	9.95	3.40	23.11	2.333
Corn, oats and barley (average of all),	9.44	4.03	20.33	2.154
Corn chop,	9.06	4.03	20.17	2.226
Corn meal,	8.87	4.66	19.82	2.234
Corn and oats feed (in general),	8.82	4.27	19.63	2.226
Victor corn and oat feed,	8.04	2.59	18.00	2.239
Sugar feed,*	7.94	7.40	16.00	2.015
Corn-and-cob chop,	7.40	3.44	16.10	2.178
Crescent oat feed,	6.82	3.25	14.75	2.148
Friends' consolidated dairy food,*	6.31	3.08	16.00	2.536
Cereal Feed American Cereal Co.),*	4.06	1.55	16.00	3.941

* One sample only.

In some of the cases included in the foregoing table, the analytical results and the prices are derived from too small a number of samples and quotations to afford a perfectly representative figure; but in the case of goods made on a large scale by manufacturers whose work is subject to chemical check, even a single analysis should approximate closely to the average composition.

The foods may therefore be divided broadly into classes as follows:

I. Cotten seed meal, containing over 40 per cent. of protein with a unit of protein requiring an expenditure of about 62 cents.

II. Buckwheat middlings and linseed meal, 30 to 35 per cent. of protein; expenditure per unit of protein, 58 to 84 cents.

III. Malt sprouts, gluten feed and germ-oil cake, 20 to 25 per cent. of protein; expenditure per unit of protein, 70 cents to $1.00.

IV. Wheat offal of various sorts, H. O. Dairy Feed and Sucrene Dairy Feed, 14 to 20 per cent. of protein; expenditure per unit of protein, $1.02 to $1.90.

V. Corn meal, corn bran and similar corn by-products, rye chop, oats chop and certain mixed cereal feeds, about 9 to 13 per cent. protein; expenditure per unit of protein, $1.10 to $2.53.

VI. Corn-and-cob chop, sugar feed, oat hulls and feeding-stuffs largely composed thereof, 4 to 9 per cent. of protein; expenditures per unit of protein, $2.01 to $3.94.

It is difficult to see how a farmer already well supplied with starchy foods and abundance of good roughage can afford to buy the foods of class VI, which are not only poorer in protein than the grain foods he already has and are less digestible as a class than corn meal; nor if he needs roughage, how he can afford to pay for fine ground mill foods when corn stover of fair quality can be bought for a lower price.

Class V contains, in addition to good foods diluted with oat hulls, many standard grain foods; they are chiefly valuable as sources of starch, and, where protein is the chief thing sought, are too expensive to buy for general feeding purposes.

It is believed that while this classification does not take into account all the items which must be considered in estimating the real cost of a single food constituent, it may prove helpful in reaching safe conclusions in many cases.

COMMERCIAL FEEDING STUFFS IN PENNSYLVANIA AS COMPARED WITH THOSE IN NEIGHBORING STATES.

For several years past, a number of the New England and Middle States have made systematic surveys of the feeding-stuffs markets of their respective territories and published the results; in some States, laws regulating the trade in such commodities, requiring some guaranty of composition and establishing a chemical control, have been enacted. Under such conditions, it would be expected that dealers would more uniformly handle articles of prime quality and fully up to their guaranteed value, than in States where such regulations and control are not in force.

The following comparative table showing the composition of some of the principal commercial feeds as sold in this State and in the New England States where various forms of control are maintained, gives ground for serious reflection on the part of the average buyer of these goods in Pennsylvania. The New England figures are obtained from a compilation of the analyses from May, 1898, to January 1, 1900. (Conn. Sta., Bulletin 130, p. 8.)

Comparative Composition of Feeding Stuffs in Different States.

	Number of samples.	Protein.	Fat.
Cotton seed meal:			
Pennsylvania,	8	44.40	10.10
New England,	205	45.40	11.12
Linseed meal:			
Old process:			
Pennsylvania,	25	33.32	5.98
New England,	25	35.70	7.20
New process:			
Pennsylvania,	3	34.25	2.63
New England,	31	38.20	2.40
Wheat bran:			
Winter wheat:			
Pennsylvania,	5	15.19	4.26
New England,	45	15.60	4.40
Spring wheat:			
Pennsylvania,	9	14.84	4.65
New England,	53	16.10	4.90
All brans analyzed:			
Pennsylvania,	39	15.30	4.48
New England,	120	15.80	4.70
Wheat middlings:			
Pennsylvania,	41	16.05	4.60
New England,	135	17.00	5.00
Mixed wheat feeds:			
Pennsylvania,	3	14.21	3.90
New England,	219	16.60	4.70
Red dog flour:			
Pennsylvania,	4	19.14	4.87
New England,	9	19.30	4.40
Corn meal:			
Pennsylvania,	15	8.87	4.66
New England,	17	9.50	4.00
Gluten feed:			
Pennsylvania,	12	24.72	2.84
New England,	69	29.68	3.74
Oat feeds:			
Crescent:			
Pennsylvania,	2	6.72	3.25
New England,	3	7.90	3.30
Others:			
Pennsylvania,	6	6.69	2.71
New England,	16	9.30	4.20
Corn-and-oat feeds:			
Victor (Am. Cereal Co.):			
Pennsylvania,	3	8.05	3.59
New England,	26	9.20	3.90
Others:			
Pennsylvania,	22	9.02	4.30
New England,	29	9.44	3.76
Quaker dairy feed (Amer. Cereal Co.):			
Pennsylvania,	2	10.94	2.88
New England,	5	12.80	2.9
Corn, oats and barley feed (Am. Cereal Co.):			
Pennsylvania,	2	10.47	4.57
New England,	6	11.9	4.5
H. O. dairy feed:			
Pennsylvania,	2	16.72	3.39
New England,	20	19.0	4.4
H. O. horse feed:			
Pennsylvania,	2	10.97	3.26
New England,	18	12.4	4.2

Commercial Feeding Stuffs Control.

The data presented in the previous pages exhibit a wide variability of composition in goods of this class selling under the same brand; the existence on the Pennsylvania market without accompanying guarantee, of large quantities of mixed feeds from whose names and appearance no adequate notion of their composition can be formed; a wide-spread use of almost valueless materials in commercial mixtures; considerable misbranding and occasional glaring adulteration. Furthermore, the average quality of the feeding stuffs sold in States that have for several years had cattle food control laws in operation, appears to be considerably superior to the quality of the goods sold under the same name in Pennsylvania.

It is believed that the preliminary comparison of the commercial cattle foods of Pennsylvania and New England made on the basis of the foregoing analyses and presented in the Preliminary Report of the Secretary of Agrictulture, 1900, pp. 47-8, supplied to the Legislature clear proof of the need for the Pennsylvania control law enacted during the present year.

Cattle food control legislation is very recent in America. The Maine and Massachusetts laws were enacted in 1897, those of Connecticut, New York and Rhode Island in 1899, followed by New Jersey and Vermont in 1900. For the purpose of affording those interested in such legislation an opportunity for the comparative study of the Pennsylvania law, the laws of the States above named are presented in the Appendix.

WEIGHTS OF FEEDING STUFFS.

For convenience of reference by those who measure instead of weigh their stable feeds, a statement of quart weights as compiled by Maj. H. E. Alvord, Chief of the Dairy Division, U. S. Dept. of Agriculture, and by Mr. H. G. Manchester (Conn. Station Bulletin No. 133, p. 13), are given below. Where differences are observed, they may fairly be attributed to a difference in the mechanical conditions of the material:

	Alvord, pounds.	Manchester, pounds.
Corn, cracked,	1.75	....
Corn meal,	1.43	1.6
Corn-and-cob meal,	1.38	....
Cotton seed meal, old process,	1.56	1.5
Gluten feed,	....	1.2
Gluten meal,	1.50	1.7
H. O. dairy feed,	....	0.7
Linseed meal, old process,	....	1.1
Oats, whole,	1.00	1.2
Oats, ground,	.75	....
Rye bran,	....	0.6
Victor corn and oat feed,	....	0.7
Wheat, whole,	1.88	....
Wheat bran, coarse,	.63	.50
Wheat middlings, coarse,	....	.80
Wheat middlings, fine,	1.13	1.1
Wheat feed, mixed,	....	.60

Note.—For composition of feeding stuffs, giving the maximum, minimum and average for each ingredient, see Appendix.

FOOD CONTROL LAWS OF THE VARIOUS STATES:

CONNECTICUT.
MAINE.
MASSACHUSETTS.
NEW JERSEY.
NEW YORK.
PENNSYLVANIA.
RHODE ISLAND.
VERMONT.

FOOD CONTROL LAWS OF THE VARIOUS STATES.

Connecticut.

An act concerning the regulation of the sale of concentrated commercial feeding stuffs.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. Every lot or parcel of concentrated commercial feeding stuff, as defined in section three of this act, used for feeding domestic animals, sold, offered, or exposed for sale within this State, shall have affixed thereto in a conspicuous place on the outside thereof, a legible and plainly printed statement, clearly and truly certifying the number of net pounds of feeding stuff contained therein, the name, brand, or trade-mark under which the article is sold, the name and address of the manufacturer or importer and a statement of the percentage it contains of crude fat and of crude protein, allowing one per cent. of nitrogen to equal six and one-fourth per cent. of protein, both constituents to be determined by the methods adopted at the time by the Association of Official Agricultural Chemists of the United States.

Section 2. The term concentrated commercial feeding stuffs as herein used shall not include hays and straws, the whole seeds nor the unmixed meals made directly from the seed of wheat, rye, barley, oats, Indian corn, buckwheat or broom corn.

Section 3. The term concentrated commercial feeding stuff as herein used shall include linseed meals, cotton seed meals, pea meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewers' grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chops, corn and oat feeds, ground beef or fish scraps, mixed feeds, provender, bran, middlings, and mixed feeds made wholly or in part from wheat, rye or buckwheat, and all materials of a similar nature not included in section two of this act.

Section 4. Each and every manufacturer, importer, agent, or seller of any concentrated commercial feeding stuff shall, upon request, file with the Connecticut Agricultural Experiment Station a certified copy of the statement named in section one of this act.

Section 5. Each and every manufacturer, importer, agent, or person selling, offering, or exposing for sale in this State any concentrated commercial feeding stuff, as defined in section three of this act, without the statement required by section one of this act, and stating that said feeding stuff contains substantially a larger percentage of either of the constituents mentioned in section one than is contained therein, or in relation to which the provisions of all of the foregoing sections have not been fully complied with, shall be fined not exceeding one hundred dollars for the first offense and not exceeding two hundred dollars for each subsequent offense.

Section 6. The Connecticut Agricultural Experiment Station is hereby authorized to have collected a sample not exceeding two pounds in weight, for analysis from any lot, parcel, or package of concentrated commercial feeding stuff as defined by section three of this act, or unmixed meals, brans, or middlings named in section two of this act, which may be in the possession of any manufacturer, importer, agent, or dealer, but said sample shall be taken in the presence of said party or parties in interest or their representatives, and taken from a number of parcels or packages which shall be not less than five per cent. of the whole lot inspected, and shall be thoroughly mixed, divided into two samples, placed in glass vessels, carefully sealed, and a label placed on each stating the name or brand of the feeding stuff or material sampled, the names of the party from whose stock the sample was taken and the time and place of taking the same, and said label shall be signed by said chemist or his deputy, and by the party or parties in interest or their representatives present at the taking and sealing of said sample; one of said samples shall be retained by said chemist or his deputy and the other by the party whose stock is sampled. Said Connecticut Agricultural Experiment Station shall cause at least one sample of each brand of feeding stuff collected as herein provided to be analyzed annually by or under the direction of said chemist. Said analysis shall include determinations of crude fat and crude protein and such other determinations as may at any time be deemed advisable. Said Connecticut Agricultural Experiment Station shall cause the analysis so made to be published in Station bulletins, together with such other additional information in relation to the character, composition, and use thereof as may seem to be of importance, and issue the same annually, or more frequently, if deemed advisable.

Section 7. It shall be the duty of the Dairy Commissioner to attend to the enforcement of this act, and when any evidence is submitted by the Connecticut Agricultural Experiment Station that the provisions of this act have been violated, he shall make complaint to the proper prosecuting officer, to the end that the violator may be prosecuted.

Section 8. The term importer for all the purposes of this act is intended to apply to such person or persons as shall bring into or offer for sale within this State, concentrated commercial feeding stuffs manufactured without this State.

Section 9. This bill shall not apply to feed ground from whole grain and sold directly from manufacturer to consumer.

Section 10. All acts or parts of acts inconsistent herewith are hereby repealed.

Section 11. This act shall take effect on and after July first, 1899.

Approved June 20, 1899.

Maine.

An act to regulate the sale and analysis of concentrated commercial feeding stuff.

Section 1. Every manufacturer, company or person who shall sell, offer or expose for sale or for distribution in this State any concentrated commercial feeding stuff, as defined in section three of this act, used for feeding farm live stock, shall, in addition to the tax tag, described in section five of this act, affix to every package of such feeding stuff in a conspicuous place on the outside thereof, a plainly printed statement clearly and truly certifying the number of net pounds in package sold or offered for sale, the name or trade mark under which the article was sold, the name of manufacturer or shipper, the place of manufacture, the place of business and the chemical analysis stating the percentage of crude protein, allowing one per cent. of nitrogen to equal six and one-fourth per cent. of protein, and of crude fat it contains, both constituents to be determined by the methods adopted at the time by the Association of Official Agricultural Chemists.

Section 2. The term concentrated commercial feeding stuff, as here used, shall not include hays and straws, the whole seeds nor the unmixed meal made directly from the entire grains of wheat, rye, barley, oats, Indian corn, buckwheat and broom corn. Neither shall it include wheat, rye and buckwheat brans or middlings not mixed with other substances, but sold separately, as distinct articles of commerce, nor pure grains ground together.

Section 3. The term concentrated commercial feeding stuff, as here used, shall include linseed meals, cotton seed meals, pea meals, cocoanut meals, gluten meals, gluten feed, maize feeds, starch feeds, sugar feeds, dried brewers' grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn-and-oat chops, ground beef or fish scraps, mixed feeds and all other materials of similar nature not included within section two of this act.

Section 4. Before any manufacturer, company or persons shall sell or offer or expose for sale in this State any concentrated commercial feeding stuffs as defined in section three of this act, he or they shall for each and every feeding stuff bearing a distinguishing name or trade mark, file with the Director of the Maine Agricultural Experiment Station a certified copy of the statement named in section one of this act, said certified copy to be accompanied, when the Director shall so request, by sealed glass jar or bottle containing at least one pound of feeding stuff to be sold or offered for sale, and the company or person furnishing said sample shall thereupon make affidavit that said sample corresponds within reasonable limits to the feeding stuffs it represents, in the percentage of protein and fat which it contains.

Section 5. Each manufacturer, importer, agent or seller of any concentrated commercial feeding stuff, as defined in section three of this act, shall pay to the Director of the Maine Agricultural Experiment Station an inspection tax of ten cents per ton for each ton of such concentrated feeding stuff sold or offered for sale in the State of Maine, and shall affix to each car shipped in bulk and to each bag, barrel or other package of such concentrated feeding stuff, a tag to be furnished by said Director, stating that all charges specified in this section have been paid. The Director of said Experiment Station is hereby empowered to prescribe the forms for such tags, and adopt such regulations as may be necessary for the enforcement of the law. Whenever the manufacturer or importer or shipper of a concentrated feeding stuff shall have filed the statement made in section one of this act and paid the inspection tax, no agent or seller of said manufacturer, importer or shipper shall be required to file such statements or pay such tax. The amount of the inspection tax received by said Director shall be paid by him into the treasury of the Maine Agricultural Experiment Station. The treasurer of said Station shall make an annual report of the receipts and expenditures of funds from this inspection tax, and all receipts in excess of three thousand dollars shall be carried into the State treasury.

Section 6. Any manufacturer, importer or person who shall sell, or offer or expose for sale or for distribution in this State any concentrated commercial feeding stuffs, as defined in section three of this act, without complying with the requirements of the preceding section of this act, or any feeding stuff which contains substantially a smaller percentage of constituents than are certified to be contained, shall, on conviction in a court of competent jurisdiction, be fined not more than one hundred dollars for the first offense, and not more than two hundred dollars for each subsequent offense.

Section 7. The Director of the Maine Experiment Station shall annually analyze, or cause to be analyzed, at least one sample to be

taken in the manner hereinafter prescribed of every concentrated commercial feeding stuff sold or offered for sale under the provisions of this act. Said Director is hereby authorized and directed in person or by deputy to take a sample, not exceeding two pounds in weight, for said analysis from any lot or package of concentrated commercial feeding stuff which may be in the possession of any manufacturer, importer, agent or dealer in this State; but said sample shall be drawn in the presence of said party or parties in interest, or their representatives, and taken from a parcel or a number of packages, which shall not be less than ten per cent. of the whole lot sampled and shall be thoroughly mixed, and then divided into two equal samples, and placed in glass vessels, and carefully sealed and a label placed on each, stating the name of brand of the feeding stuff or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the Director, or his deputy, and by the party or parties in interest or their representatives at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the Director and the other by the party whose stock was sampled; and the sample or samples retained by the Director shall be for comparison with the certified statement named in section four of this act. The result of the analysis of the sample or samples so procured, together with such additional information as circumstances advise, shall be published in the report or bulletins from time to time.

Section 8. Whenever the Director becomes cognizant of the violation of any of the provisions of this act, he shall report such violation to the Secretary of the Board of Agriculture, and said Secretary shall prosecute the party or parties thus reported; but it shall be the duty of said Secretary, upon thus ascertaining any violation of this act, to forthwith notify the manufacturer, importer or dealer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act; but there shall be no prosecution in relation to the quality of any concentrated commercial feeding stuff if the same shall be found substantially equivalent to the certified statement named in section four of this act.

Section 9. All acts and parts of acts inconsistent with this act are hereby repealed.

Section 10. This act shall take effect October the 1st, 1897.

Massachusetts.

An act relative to concentrated commercial feed stuffs.

Section 1. The Director of the Hatch Experiment Station of the Massachusetts Agricultural College is hereby authorized and directed

in person or by deputy, to take samples not exceeding two pounds in weight from any lot or package of concentrated commercial feed stuff, used for feeding any kind of farm live stock, which may be in the possession of any manufacturer, importer, agent or dealer, cause the same to be analyzed for the amount of crude protein and crude fat contained therein, as well as for other ingredients if thought advisable, and cause the results of the analyses to be published from time to time in specially prepared bulletins, with such additional information as circumstances advise: Provided, however, That in publishing the results of the analyses the names of the jobbers or local dealers selling the said feed stuffs shall not be used, but the commodity analyzed shall be identified and described by the name of the manufacturer and the commercial name or designation by which it is known in the trade.

Section 2. Whenever requested said samples shall be taken in the presence of the party or parties in interest or their representatives and shall in all cases be taken from a parcel or number of packages which shall not be less than five per cent. of the whole lot inspected, shall be thoroughly mixed and then divided into two equal samples and put in glass vessels and carefully sealed, and a label placed on each vessel stating the name or brand of the feed stuff or material sampled, the name of the manufacturer when possible, the name of the party from whose stock the sample was taken, and the time and place of taking; said label shall be signed by the Director, or his deputy, and by the party or parties in interest or their representatives, if present at the taking and sealing of the samples. One of said duplicate samples shall be retained by the Director and the other by the party whose stock was sampled.

Section 3. This act shall take effect on the first day of July in the year eighteen hundred and ninety-seven. (Approved March 5, 1897.)

New Jersey.

Be it enacted by the Senate and General Assembly of the State of New Jersey:

1. Every lot or parcel of concentrated commercial feeding stuff as defined in section two of this act, used for feeding domestic animals, sold, offered or exposed for sale within this State, shall have affixed thereto, in a conspicuous place on the outside thereof a legible and plainly printed statement, clearly and truly certifying the number of net pounds of feeding stuff contained therein, the name, brand

or trade mark under which the article is sold, the name and address of the manufacturer or importer, and a statement of the percentage it contains of crude fat and of crude protein, allowing one per centum of nitrogen to equal six and one-fourth per centum of protein, both constituents to be determined by the methods of the Association of Official Agricultural Chemists of the United States; but if the feeding stuff is sold in bulk or in packages belonging to the purchaser, the agent or dealer, upon request of the purchaser, shall furnish to him the certified statement named in this section.

2. The term concentrated commercial feeding stuff used in this act shall include linseed meal, cotton seed meals, pea meals, peanut meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewers' grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chop, ground beef or fish scraps, mixed feeds, and all other materials of similar nature.

3. The term concentrated commercial feeding stuffs shall not include hays and straws, the whole seeds nor the unmixed meals made directly from the entire grains of wheat, rye, barley, oats, Indian corn, buckwheat and broom corn; neither shall it include wheat, rye and buckwheat brans or middlings, not mixed with other substances, but sold separately, as distinct articles of commerce, nor pure grains ground together.

4. Each and every manufacturer, importer, agent or seller of any concentrated commercial feeding stuff shall, during the month of November, file with the New Jersey Agricultural Experiment Station a certified copy of the statement named in section one of this act and, upon request, shall furnish a sealed glass jar or bottle containing a representative sample of at least one pound of the feeding stuff to be sold or offered for sale.

5. Each and every manufacturer, importer, agent or person selling, offering or exposing for sale in this State any concentrated commercial feeding stuff, as defined in section two of this act, without the statement required by section one of this act, or stating that said feeding stuff contains substantially a larger percentage of either of the constituents mentioned in section one than is contained therein, or in relation to which the provisions of all the foregoing sections have not been fully complied with, shall be fined not exceeding one hundred dollars for the first offense, and not exceeding two hundred dollars for each subsequent offense.

6. Any person who shall adulterate any kind of meal or ground grain with milling or manufacturing offals, or any other substance whatever, for the purpose of sale, unless the true composition, mixture or adulteration thereof is plainly marked or indicated upon the package containing the same, or in which it is offered for sale or any

person who knowingly sells or offers for sale any meal or ground grain which has been so adulterated, unless the true composition, mixture, or adulteration is plainly marked or indicated upon the package containing the same, or in which it is offered for sale shall be fined not less than twenty-five dollars nor more than one hundred dollars for each offense.

7. All penalties imposed under this act shall be paid into the treasury of this State, for the purpose of defraying the expenses of the prosecution.

8. The New Jersey Agricultural Experiment Station is hereby authorized to have collected a sample, not exceeding two pounds in weight, for analysis, from any lot, parcel or package of any concentrated commercial feeding stuff as defined by section two of this act, or any kind of material which is used in the feeding of domestic animals, and which may be in the possession of any manufacturer, importer, agent or dealer, but said sample shall be taken in the presence of said party or parties in interest, or their representatives, and taken from a number of parcels or packages which shall not be less than five per centum of the whole lot inspected, and shall be thoroughly mixed, divided into two samples, placed in glass vessels, carefully sealed, and a label placed on each stating the name or brand of the feeding stuff or material sampled, the name of the party from whose stock the sample was taken, and the time and place of taking the same, and said label shall be signed by the collector or his deputy, and by the party or parties in interest or their representatives present at the taking and sealing of said samples; one of said samples shall be retained by the collector or his deputy, and the other by the party whose stock is sampled; said New Jersey Agricultural Experiment Station shall cause at least one sample of each brand of feeding stuff collected as herein provided to be analyzed annually; said analysis shall include determinations of crude fat and crude protein, and such other determinations as may at any time be deemed advisable; said New Jersey Agricultural Experiment Station shall cause the analysis so made to be published in Station bulletins, together with such other additional information in relation to the character, composition and use thereof as may seem to be of importance, and issue the same annually, or more frequently, if deemed advisable.

9. Whenever the New Jersey Agricultural Experiment Station becomes cognizant of the violation of any of the provisions of this act, such violation shall be reported to the Secretary of the State Board of Agriculture, and said Secretary of the State Board of Agriculture shall make complaint to the proper prosecuting officer to the end that the violator may be prosecuted.

10. The term importer for all the purposes of this act is intended to apply to such person or persons as shall bring into or offer for sale within this State, concentrated commercial feeding stuffs manufactured without this State.

11. The expenses incurred by the New Jersey Agricultural Experiment Station in carrying out the provisions of this act, when presented to the comptroller of the State, accompanied by the proper vouchers, duly certified by the President and Secretary of the Board of Managers, shall upon warrant of said comptroller be paid out of the State treasury: Provided, Such expenses do not exceed the sum of three thousand dollars in any year.

12. This act shall take effect when the sum provided for expenses in section eleven has been duly appropriated.

Passed March 15, 1900.

New York.

The people of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Chapter three hundred and thirty-eight of the laws of eighteen hundred and ninety-three, entitled "An act in relation to agriculture, constituting articles one, two, three, four and five of chapter thirty-three of the general laws," is hereby amended by adding at the end thereof a new article to be known as article nine, and to read as follows:

Article IX.

Sale and analysis of concentrated commercial feeding stuffs.

Section 120. Term "concentrated commercial feeding stuffs" defined.

Section 121. Statements to be attached to packages; contents; analysis.

Section 122. Statements to be filed with Director of Agricultural Experiment Station; to be accompanied by sample.

Section 123. License fee.

Section 124. Analysis to be made by Director of Experiment Station; samples to be taken for analysis.

Section 125. Penalty for violation of article.

Section 126. Sale of adulterated meal or ground grains; penalty.

Section 127. Violation to be reported to the Commissioner of Agriculture.

120. *Term "concentrated commercial feeding stuffs" defined:* The term "concentrated commercial feeding stuffs," as used in this article shall include linseed meals, cotton-seed meals, pea meals, cocoa-

nut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewers' grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chops, ground beef or fish scraps, mixed feeds, and all other material of similar nature; but shall not include hays and straws, the whole seeds nor the unmixed meals made directly from the entire grains of wheat, rye, barley, oats, Indian corn, buckwheat and broom corn. Neither shall it include wheat, rye and buckwheat brans or middlings, not mixed with other substances, but sold separately, as distinct articles of commerce, nor pure grains ground together.

121. *Statements to be Attached to packages; contents; analysis:* Every manufacturer, company or person who shall sell, offer or expose for sale or for distribution in this State any concentrated commercial feeding stuff, used for feeding farm live stock, shall furnish with each car or other amount shipped in bulk and shall affix to every package of such feeding stuff in a conspicuous place on the outside thereof, a plainly printed statement clearly and truly certifying the number of net pounds in the package sold or offered for sale, the name or trade mark under which the article is sold, the name of the manufacturer or shipper, the place of manufacture, the place of business and a chemical analysis stating the percentages it contains of crude protein, allowing one per centum of nitrogen to equal six and one-fourth per centum of protein, and of crude fat, both constituents to be determined by the methods prescribed by the Director of the New York Agricultural Experiment Station. Whenever any feeding stuff is sold at retail in bulk or in packages belonging to the purchaser, the agent or dealer, upon request of the purchaser, shall furnish to him the certified statement named in this section.

122. *Statements to be filed with Director of Agricultural Experiment Station; to be accompanied by sample.* Before any manufacturer, company or person shall sell, offer or expose for sale in this State any concentrated commercial feeding stuffs, he or they shall for each and every feeding stuff bearing a distinguishing name or trade mark, file annually during the month of December with the Director of the New York Agricultural Experiment Station a certified copy of the statement specified in the preceding section, said certified copy to be accompanied, when the Director shall so request, by a sealed glass jar or bottle containing at least one pound of the feeding stuff to be sold or offered for sale, and the company or person furnishing said sample shall thereupon make affidavit that said sample corresponds within reasonable limits to the feeding stuff which it represents, in the percentage of protein and fat which it contains.

123. *License fee.* Each manufacturer, importer, agent or seller of any concentrated commercial feeding stuffs shall pay annually during the month of December to the treasurer of the New York Agricultural Experiment Station a license fee of twenty-five dollars. Whenever a manufacturer, importer, agent or seller of concentrated commercial feeding stuffs desires at any time to sell such material and has not paid the license fee therefor in the preceding month of December, as required by this section, he shall pay the license fee prescribed herein before making any such sale. The amounts of license fees received by such treasurer pursuant to the provisions of this section shall be paid by him to the treasurer of the State of New York. The treasurer of the State of New York shall pay from such amount when duly appropriated the moneys required for the expense incurred in making such inspection required by this section and enforcing the provisions thereof. The Board of Control of the New York Agricultural Experiment Station shall report annually to the Legislature the amount received pursuant to this article, and the expense incurred for salaries, laboratory expenses, chemical supplies, traveling expenses, printing and other necessary matters. Whenever the manufacturer, importer or shipper of concentrated commercial feeding stuffs shall have filed the statement required by section one hundred and twenty-one of this article and paid the license fee as prescribed in this section, no agent or seller of such manufacturer, importer or shipper shall be required to file such statement or pay such fee.

124. *Analysis to be made by Director of Experiment Station; samples to be taken for analysis.* The Director of the New York Experiment Station shall annually analyze, or cause to be analyzed, at least one sample to be taken in the manner hereinafter prescribed, of every concentrated commercial feeding stuff sold or offered for sale under the provisions of this act. Said Director shall cause a sample to be taken, not exceeding two pounds in weight, for said analysis, from any lot or package of such commercial feeding stuff which may be in the possession of any manufacturer, importer, agent or dealer in this State; but said samples shall be drawn in the presence of the parties in interest, or their representatives and taken from a parcel or a number of packages, which shall not be less than ten per centum of the whole lot sampled, and shall be thoroughly mixed, and then divided into equal samples, and placed in glass vessels, and carefully sealed and a label placed on each, stating the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the person taking the sample, and by the party or parties in interest or their representatives at the drawing and sealing of said samples; one of said duplicate sam-

ples shall be retained by the Director and the other by the party whose stock was sampled; and the sample or samples retained by the Director shall be for comparison with the certified statement named in section one hundred and twenty-two of this article. The result of the analyses of the sample or samples so procured, together with such additional information as circumstances advise, shall be published in reports or bulletins from time to time.

125. *Penalty for violation of article.* Any manufacturer, importer, or person who shall sell, offer or expose for sale or for distribution in this State any concentrated commercial feeding stuff, without complying with the requirements of this article, or any feeding stuff which contains substantially a smaller percentage of constituents than are certified to be contained, shall, on conviction in a court of competent jurisdiction, be fined not more than one hundred dollars for the first offense, and not more than two hundred dollars for each subsequent offense.

126. *Adulterated meal or ground grain; penalty.* Any person who shall adulterate any kind of meal or ground grain with milling or manufacturing offals, or any other substance whatever, for the purpose of sale, unless the true composition, mixture or adulteration thereof is plainly marked or indicated upon the package containing the same or in which it is offered for sale; or any person who knowingly sells, or offers for sale any meal or ground grain which has been so adulterated unless the true composition, mixture or adulteration is plainly marked or indicated upon the package containing the same, or in which it is offered for sale, shall be fined not less than twenty-five or more than one hundred dollars for each offense.

127. *Violation to be reported to the Commissioner of Agriculture.* Whenever the Director becomes cognizant of the violation of any of the provisions of this article, he shall report such violation to the Commissioner of Agriculture, and said Commissioner of Agriculture shall prosecute the party or parties thus reported; but it shall be the duty of said Commissioner upon thus ascertaining any violation of this article, to forthwith notify the manufacturer, importer or dealer in writing and give him not less than thirty days thereafter in which to comply with the requirements of this article; but there shall be no prosecution in relation to the quality of any concentrated commercial feeding stuff if the same shall be found substantially equivalent to the certified statement named in section one hundred and twenty-two of this article.

Section 2. This act shall take effect December first, eighteen hundred and ninety-nine.

Pennsylvania.

AN ACT

Regulating the sale of concentrated commercial feeding stuffs, defining concentrated feeding stuffs, prohibiting their adulteration, providing for the collection of samples, the expenses of the enforcement of the law, and fixing penalties for its violation.

Section 1. Be it enacted, &c., That every lot or parcel of any concentrated commercial feeding stuff, as defined in section two of this act, used for feeding domestic animals, sold, offered or exposed for sale within this State, shall have affixed thereto, in a conspicuous place on the outside thereof, a legible and plainly printed statement clearly and truly certifying the number of net pounds of feeding stuff contained therein; the name, brand or trade mark under which the article is sold; the name and address of the manufacturer or importer, and a statement of the percentage it contains of crude fat and of crude protein, both constituents to be determined by the methods adopted at the time by the Association of Official Agricultural Chemists of the United States. Whenever any concentrated commercial feeding stuff is sold at retail, in bulk, or in sacks belonging to the purchaser, the agent or dealer, upon request of the purchaser, shall furnish to him the certified statement named in this section.

Statement certifying weight of material, the name or trade mark, etc.

When statement is to be furnished the purchaser.

Section 2. The term "concentrated commercial feeding stuffs," as used in this act, shall include linseed meals, cotton seed meals, gluten meals, maize feeds, starch feeds, sugar feeds, dried brewers' grains, malt sprouts, hominy foods, cerealine feeds, rice meals, ground beef or fish scraps, and all other materials of similar nature, but shall not include hays and straws, the grinding together of pure whole grains, nor the unmixed meals made directly from the entire grains of wheat, rye, barley, oats, Indian corn, buckwheat or broom corn; neither shall it include wheat, rye or buckwheat bran, or middlings not mixed with other substances, and sold separately as distinct articles of commerce.

"Concentrated commercial feeding stuffs" defined.

Section 3. No foreign mineral substance, nor substance injurious to the health of domestic animals, shall be mixed with any feeding stuff sold, or offered, or exposed for sale in this State.

Injurious substances shall not be used.

Filing of certified statement.

Section 4. Each and every manufacturer, importer, agent or seller of any concentrated feeding stuff shall, upon request, file in the office of the Secretary of Agriculture a certified copy of the statement named in section one of this act.

Penalty for omission of statement.

Proviso.

Powers and duties of Secretary of Agriculture and his agents.

The taking and labeling of samples.

[illegible] of samples.

Section 5. Each and every manufacturer, importer, agent or person selling, offering or exposing for sale in this State any concentrated commercial feeding stuff, as defined in section two of this act, without the statement required by section one of this act; or affixing a statement or guarantee which is false in any particular, or in relation to which the provisions of all of the foregoing sections have not been fully complied with, shall, for every such offense, forfeit and pay the sum of one hundred dollars, which shall be recoverable with costs, including the expenses of analysis, by any person suing in the name of the Commonwealth, as debts of like amount are by law recoverable: Provided, That the Secretary of Agriculture shall, together with his deputies, agents and assistants, be charged with the enforcement of this act, and shall have full access to all places of business, mills, buildings, carriages, cars, vessels and packages, of whatsoever kind, used in the manufacture, importation or sale of any concentrated commercial feeding stuff; and shall also have power and authority to open any package containing or supposed to contain any concentrated commercial feeding stuff, and take therefrom samples for anaysis, upon tendering the value of said sample; and whenever requested, said samples shall be taken in the presence of the party or parties interested or their representative, shall be thoroughly mixed and then divided into two samples and put in glass vessels and carefully sealed and a label placed upon each vessel stating the name or brand of the feeding stuff or material sampled, the name of the manufacturer when possible, the name of the party from whose stock the sample was taken, and the time and the place of taking, said labels to be signed by the Secretary of Agriculture or his agent, and by the party or parties interested or their representative, if present, at the taking of the samples. One of said duplicate samples shall be retained by the Secretary of Agriculture or his agent, and the other by the party whose stock was sampled.

Section 6. All necessary expenses under the provisions of this act shall, after approval in writing by the Governor and the Secretary of Agriculture, be paid by the State Treasurer upon the warrant of the Auditor General, in the same manner now provided by law: Provided, That not more than five thousand dollars shall be expended in any one year, and all penalties and costs for the violation of the provisions of this act shall be paid to the said Secretary of Agriculture or his agent, and by him immediately covered into the State Treasury, to be kept as a separate fund, for the use of the Department in carrying out the provisions of this act, and to be drawn out upon warrants signed by the Secretary of Agriculture and the Auditor General. Payment of necessary expenses. Proviso. Application of penalties and costs.

Section 7. Every person who violates any of the provisions of this act shall also be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than fifty dollars nor more than one hundred dollars, or by imprisonment in the county jail for not less than ten nor more than thirty days, or both fine and imprisonment for the first offense, and a fine of one hundred dollars and imprisonment for every subsequent offense: Provided, That all fines and costs, including the expenses of analysis, imposed and recovered under this section shall be covered into the State Treasury, as provided by section six of this act. Violation of act a misdemeanor. Fine and penalty. Proviso.

Section 8. Magistrates and justices of the peace throughout this Commonwealth shall have jurisdiction to hear and determine actions arising from violation of the provisions of this act, and to hold for court or impose the penalties prescribed therein, subject to appeal as the law shall direct. Jurisdiction of magistrates.

Section 9. This act shall take effect on the first day of October, one thousand nine hundred and one. Act to take effect

Section 10. All acts or parts of acts inconsistent with the provisions of this act are hereby repealed. Repeal.

Approved—The 25th day of April, A. D. 1901.

WILLIAM A. STONE.

Rhode Island.

An act to regulate the sale of concentrated commercial feeding stuffs.

It is enacted by the General Assembly as follows:

Section 1. Every lot or parcel of any concentrated commercial feeding stuff, as defined in section 3 of this act, used for feeding domestic animals, sold, offered, or exposed for sale, in this State, shall have affixed thereto, in a conspicuous place on the outside thereof, a legible and plainly printed statement, stating and truly certifying the number of net pounds of feeding stuffs contained therein, the name, brand, or trade mark under which the article is sold, the name and address of the manufacturer or importer, and a statement of the percentage it contains of crude protein, allowing one per cent. of nitrogen to equal six and one-fourth per cent. of protein, and of crude fat, both constituents to be determined by the methods adopted at the time by the Association of Official Agricultural Chemists of the United States.

Section 2. The term concentrated commercial feeding stuff, as herein used, shall not include hays and straws, the whole seeds, nor the unmixed meals made directly from the seed of wheat, rye barley, oats, Indian corn, buckwheat or broom corn; nor shall it include wheat, rye and buckwheat brans or middlings unmixed with other substances and sold separately as distinct articles of commerce.

Section 3. The term concentrated commercial feeding stuffs, as herein used, shall include linseed meals, cotton seed meals, pea meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewers' grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chop, corn and oat feeds, ground beef or fish scraps, mixed feeds, provenders, and all materials of a similar nature not included within section 2 of this act.

Section 4. Each and every manufacturer, importer, agent, or seller of any concentrated commercial feeding stuff, shall, upon request, file with the Board of Managers of the Rhode Island College of Agriculture and Mechanic Arts, a certified copy of the statement named in section 1 of this act.

Section 5. Each and every manufacturer, importer, agent, or person selling, offering, or exposing for sale in this State any concentrated commercial feeding stuff, as defined in section 3 of this act, without the statement required by section 1 of this act, stating that said feeding stuff contains substantially a larger percentage of either of the constituents mentioned in section 1 than is contained therein, or in relation to which the provisions of all the foregoing sections have not been fully complied with, shall be fined not exceeding one hundred dollars for the first offense, and not exceeding two hundred dollars for each subsequent offense.

Section 6. The Board of Managers of the Rhode Island College of Agriculture and Mechanic Arts is hereby authorized to have collected by the chemist of the Agricultural Experiment Station, or by a deputy or deputies of said chemist, a sample, not exceeding two pounds in

weight, for analysis, from any lot, parcel, or package of concentrated commercial feeding stuff as defined by section 3 of this act, or unmixed meals, brans, or middlings named in section 2 of this act, which may be in the possession of any manufacturer, importer, agent or dealer, but said sample shall be taken in the presence of such party or parties in interest, or their representatives, and taken from a number of parcels or packages which shall not be less than five per cent. of the whole lot inspected, and shall be thoroughly mixed, divided into two samples, placed in glass vessels, carefully sealed, and a label placed on each stating the name or brand of the feeding stuff or material sampled, the name of the party from whose stock the sample was taken, and the time and place of taking the same; and said label shall be signed by said chemist, or his deputy, and by the party or parties in interest, or their representatives, present at the taking or sealing of said sample; one of said samples shall be retained by said chemist, or his deputy, and the other by the party whose stock was sampled. Said Board of Managers shall cause at least one sample of each brand of feeding stuff collected, as herein provided, to be analyzed annually by or under the direction of said chemist. Said analysis shall include determinations of crude fat and crude protein and such other determinations as may be at any time deemed advisable. Said Board of Managers shall cause the analyses so made to be published in Station bulletins, together with such additional information in relation to the character, composition, and use thereof as may seem to be of importance and issue the same annually, or more frequently if deemed advisable.

Section 7. It shall be the duty of the Board of Managers of the Rhode Island College of Agriculture and Mechanic Arts to prosecute every person violating the provisions of this act, and for this purpose said Board of Managers may employ experts, if necessary, and may designate some one of their own number, or some person connected with said College, to make complaints in its behalf, and, in making complaints for violations thereof, such person so designated shall not be required to enter into any recognizance or give surety for the payment of costs.

Section 8. The term importer, for all the purposes of this act, is intended to apply to such person or persons as shall bring into and offer for sale, within this State, concentrated commercial feeding stuffs manufactured without the State.

Section 9. The sum of thirteen hundred dollars, or so much thereof as may be necessary, is hereby appropriated, annually, out of any money in the treasury not otherwise appropriated, for the purpose of defraying the expenses of collection, analysis, distribution of bulletins, correspondence, laboratory fittings, chemicals, and such other expenses as are incident to and properly arise from the execution of

the provisions of this act; and the State Auditor shall draw his order upon the general treasurer for said sum, or so much thereof as may be necessary, on the presentation of vouchers properly authenticated by the Board of Managers of the Rhode Island College of Agriculture and Mechanic Arts, and approved by the Governor.

Section 10. This act shall take effect on and after July 1st, 1899.

Vermont.

An act to regulate the sale of concentrated commercial feeding stuffs.

It is hereby enacted by the General Assembly of the State of Vermont:

Section 1. Every lot or parcel of any concentrated commercial feeding stuff, as defined in section three of this act, used for feeding farm live stock, sold, offered or exposed for sale in the State of Vermont, shall, in addition to the tax tag described in section five of this act, have affixed thereunto, in a conspicuous place on the outside thereof, a plainly printed statement clearly and truly certifying the number of net pounds of feeding stuff in a package, the name, brand or trade mark under which the article is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentages it contains, of crude protein, allowing one per cent. of nitrogen to equal six and one-fourth per cent. of protein, and of crude fat, both constituents to be determined by the methods adopted at the time by the Association of Official Agricultural Chemists: Provided, That the statement of the percentage of crude fat may be omitted if it does not exceed three per cent.

Section 2. The term concentrated commercial feeding stuff, as here used, shall not include hays and straws, the whole seed nor the unmixed meals made directly from the entire grains of wheat, rye, barley, oats, Indian corn, buckwheat and broom corn. Neither shall it include wheat, rye and buckwheat brans or middlings, nor pure grains ground together, nor wheat bran or middlings mixed together or with other feed.

Section 3. The term concentrated commercial feeding stuff, as here used, shall include linseed meals, cotton-seed meals, pea meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewers' grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chops, corn and oat feeds, ground beef or fish, mixed feeds, provenders, and all other materials of a similar nature not included within section two of this act.

Section 4. Before any concentrated commercial feeding stuff, as defined in section three of this act, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offers it for sale within the State of Vermont, shall, for each and every feeding stuff bearing a distinguishing name and trade mark, file with the Director of the Vermont Agricultural Experiment Station a certified copy of the statement named in section one of this act, and shall also deposit with said Director, at his request, a sealed glass jar or bottle containing not less than one pound of the feeding stuff to be sold or offered for sale, accompanied by an affidavit that it is a fair average sample thereof and corresponds within reasonable limits to the feeding stuff which it represents in the percentage of protein and fat which it contains.

Section 5. The manufacturer, importer, agent or seller of each concentrated commercial feeding stuff as defined in section three of this act, shall, before the article is offered for sale, pay to the Director of the Vermont Agricultural Experiment Station an inspection tax of ten cents per ton for each ton of such concentrated feeding stuff sold or offered for sale in the State of Vermont, and shall affix to each car shipped in bulk and to each bag, barrel or other package of such concentrated feeding stuff, a tag to be furnished by said Director, stating that all charges specified in this section have been paid. The Director of said Experiment Station is hereby empowered to prescribe the forms for such tags, and adopt such regulations as may be necessary for the enforcement of the law. Whenever the manufacturer or importer or shipper of a concentrated feeding stuff shall have filed the statement made in section one of this act and paid the inspection tax, no agent or seller of said manufacturer, importer or shipper shall be required to file such statement or pay such tax. The amount of inspection tax received by said Director shall be paid by him to the State Treasurer. So much of the inspection tax collected under this act shall be paid by the State Treasurer to the treasurer of said Experiment Station as the Director of said Experiment Station may show by his bills has been expended in performing the duties required by this act, but in no case to exceed the amount of the inspection tax received by the State Treasurer under this act, such payment to be made quarterly upon the order of the Auditor of Accounts, who is hereby directed to draw his order for such purpose.

Section 6. Any manufacturer, importer, agent or person selling, offering or exposing for sale any concentrated commercial feeding stuff, as defined in section three of this act, without the statement required by section one and the tax tag required by section five of this act, or with a label stating that said feeding stuff contains substantially a larger percentage of either of the constituents mentioned

in section one than is contained therein, shall on conviction in a court of competent jurisdiction be fined not more than fifty dollars for the first offense, and not more than one hundred dollars for each subsequent offense.

Section 7. All manufacturers and importers of concentrated commercial feeding stuffs, or dealers in the same, shall, when requested, furnish the Director of the Vermont Agricultural Experiment Station with a complete list of the names or trade marks of said feeding stuffs, and all agents selling, offering or exposing the same for sale.

Section 8. The Director of the Vermont Agricultural Experiment Station shall cause one analysis or more to be made annually of each concentrated commercial feeding stuff sold or offered for sale under the provisions of this act. Said Director is hereby authorized in person or by deputy to take a sample not exceeding two pounds in weight for analysis from any lot or package of concentrated commercial feeding stuff which may be in the possession of any manufacturer, importer, agent or dealer in this State; but said sample shall be drawn in the presence of said party or parties in interest, or their representative, and shall be taken from a parcel or number of packages which shall not be less than five per cent. of the whole lot inspected, and shall be thoroughly mixed and divided into two equal samples and placed in glass or metal vessels, carefully sealed and a label placed on each stating the name or brand of the feeding stuff or material sampled, the name of the party from whose stock the sample was drawn, and the time and place of drawing, and said label shall be signed by the Director or his deputy and the parties or party in interest, or their representative, present at the drawing and sealing of said sample; one of said duplicate samples shall be retained by the Director and the other by the party whose stock was sampled, and the sample or samples retained by the Director shall be for comparison with the certified statements named in sections one and four of this act. The result of the analysis of the sample or samples so procured, together with such additional information as circumstances advise shall be published in reports or bulletins from time to time.

Section 9. The Director of the Vermont Agricultural Experiment Station shall notify the State Treasurer of all violations of this act, and the State Treasurer shall commence a suit in the name of the State against the party or parties thus reported. It shall be the duty of the Treasurer upon ascertaining any violation of this act to forthwith notify the manufacturers and importers, in writing, and to give them not less than thirty days thereafter in which to comply with the requirements of this act. But there shall be no prosecution in relation to the quality of any concentrated feeding stuff if the same shall be found to be substantially equivalent to the statement of analysis made by the manufacturers or importers.

Section 10. The term importer, for all the purposes of this act, shall be taken to mean all who procure or sell concentrated commercial feeding stuffs.

Section 11. All acts or parts of acts inconsistent with this act are hereby repealed.

Section 12. This act shall take effect July 1st, 1899.

Approved November 29, 1898.

QUALIFICATIONS ESSENTIAL TO THE SUCCESSFUL FARMER.

BY D. A. KNUPPENBURG, *Lake Carey, Wyoming County.*

I am just as proud to stand up anywhere, and say "I am a farmer," as ever David Hill was to say "I am a Democrat."

And I am equally proud of the fact that I am a farmer in the ranks, one whose time is spent in doing and in directing the labor of the farm. It is not that I am a teacher of teachers, an instructor, or a representative of any of the learned professions that I owe my invitation to be present with you to-day; but because I come from the working ranks of Pennsylvania's farmers, and I shall attempt to give you briefly my idea of those qualities necessary to make a successful farmer.

Qualification, is a word that means much. We understand by it any natural endowment or acquirement which fits a person for a place, office or employment; or enables him to sustain any character with success.

And first, the farmer must love the pursuit of his chosen occupation; for if it is distasteful and void of pleasure, that will be a clog to the wheels of progress, that will be a hindrance and a burden. The man becomes discontented, sour and irritated, and those influences are soon communicated and felt by every person, by every animal and by all with whom he comes in contact.

To be successful, I say, he must first, love his occupation, for "better is a dinner of herbs where love is, than a stalled ox and hatred therewith." It is a truth, the importance of which can hardly be over estimated, that nearly every successful member of any profession owes his success largely to the fact, that he pursues it, not for the slavish hunger after emoluments, but from a genuine love for it, and a satisfaction in discharging its duties efficiently and well. If the mason enjoys seeing his work stand the test of plumb-line and spirit level, so the would-be successful farmer should feel the thrill of satisfaction as his eye passes down the furrows evenly and systematically run. So, on this point, I would say, love it, or leave it.

The art of husbandry dates back thousands of years, and millions of men have made dismal failures of the business, others have made

a poor living and have died discouraged and in debt, while still others have enjoyed beautiful and happy homes, leaving the comforts, yes, even the luxuries of earth to their posterity, because they loved, and loved wisely, their chosen vocation.

A horse that trots a mile in five minutes, with proper training, the same horse easily does it in four; continue to train him and he will do it in three minutes. As the horse develops superior speed, so the farmer, by mental training, develops superior abilities in the management of his chosen business. Blackstone loved the law; Morse loved electricity; and their names have gone down to posterity closely linked with the pursuits they loved. Just as truly must the farmer, who will succeed, love to hear the bleating of the lambs, the crowing of the cock, and even the deep bass voice of the well-bred bovine sire. There is a love, deeper and nobler than the mere monetary reward, that must stand on guard to keep the baser beneath it, a natural God-given love for home with those pleasant and beautiful surroundings, found and prized so often on the orderly and well tilled farm.

Of the lesser qualifications, the farmer who would succeed must have order in his make-up, order developed and rounded out by constant practice. Order is heavens first law, and without it chaos reigns on the farm, as in the universe. I believe a man should have will power sufficient to control and manage men, as well as animals, and to do this he must first, learn to know and control himself, for it is just as true to-day as it was in Solomon's time, that he that ruleth his spirit is greater than he that taketh a city. With order he must possess promptness which is the key to success. Too late, means failure, more than once or twice.

He must be honest. I fail to find better words than those so often repeated, the old reliable "honesty is always the best policy." Honesty not only best serves the farmer, but all men, whatever their place, condition or calling. If honest, he will be truthful, for dishonesty is of the father of lies.

He should be temperate in all things. These are trite and ordinary words, but there are none truer, for the intemperate man can never grasp success. My farmer who is to succeed must be temperate, not only in his eating and in his drinking, but must avoid those other forms of intemperance seldom or never spoken of, that drag strong men stealthily down to premature graves.

Then my ideal farmer must be a man of broad and liberal education. I will not insist on his being college bred, for even the men who are trained in the universities do not get their best education and training; it comes in later life through the utilizing of the spare moments of each day. There is no excuse for the farmer who does not read the best books, and who does not keep up with the literature of the times.

I believe there is no occupation known to man of greater importance, or that admits of wider scope for thought than that of agriculture. It is the very foundation of all our greatness. Only recently I heard a learned speaker say that in the event of war with Great Britain, so great is her dependence upon our unbounded agricultural resources, that we could starve her into submission in six months. We eat to live; therefore, I say with boldness, that agriculture is first of the occupations of men, and first in honor.

Now that you have my idea as to the qualifications of the successful farmer, the question will naturally come to us all, "How can we foster, build up and produce this kind of a farmer?" And right here I wish to say that I fully appreciate what is being done in the old Keystone State through our farm organizations, the Grange, the Farmers' Alliance, Farm Clubs, Fair Associations, Farmers' Institutes, all fostered under the watchful eye of the State Board of Agriculture. Without a well organized State Board, we are as a great ship out on the broad ocean, with no rudder, learned captain, or skilled crew. It is well, that the farmer has a place to look for advice and guidance in case of emergency, and this he has in our State Board of Agriculture, headed, as I believe it is by competent, practical, energetic and honest men. It may be true, that the Board, being human, have made mistakes. There will be mistakes as long as men inhabit the earth, but when men learn to be as ready and willing to overlook them as they are now to find fault and to criticise, they will give their superiors that hearty support that will send them onward in their honest endeavors to promote their best interests, and in their closer touch with the people greater and more efficient work will be accomplished. It is gratifying to mark the improvement where farmers are brought together and taught the improved methods in farming, and witness their eagerness to learn the ways in which farming conditions can be better improved.

But to return to our ideal farmer. He should be well balanced, self-possessed, persistent and able to decide for the best, and then work towards his plan. These are the qualifications I have in mind, and with these there is no business more pleasant and profitable than the pursuits pertaining to the farm. Think, for a moment, of the home of the successful farmer; you all know what it means. Glance back to the dear old home of your childhood; see the ample farm house, embowered in leafy shade, with its springs of pure water, its cellars stocked with delicious fruits and vegetables, and all presided over by a ruddy faced stalwart man, the head supplemented by that genius of the home, the lovely wife, partner of his joys and sorrows, God's best gift to man; a family of healthful, happy boys and girls growing up around them, the best investment in all their

domain, if properly guided and controlled, for in them they have strong supporters to lean upon when the evening shadows of life approach and they begin to be afraid of that which is nigh. In this dear old home that memory paints again and again for us, we know that the farmer has the best of the fruits of the earth; and from his stores of poultry, beef, mutton and pork, he may take his choice before sending the surplus to the markets of the world.

No occupation or profession is exempt or immune from the "crank," and we find now and then one among the farmers, men who tell us that there is too much time and money spent on the Farmers' Institutes, State Colleges and the like. They take delight in saying, in season and out of season, usually the latter, that more time spent in work would give better results and save the waste of a lot of good money. They love to tell us how they and their fathers farmed, but utterly fail to see how the conditions have changed during the last century, or the last decade even. New land then, now old and poor, worn out through their mistakes and neglect. These men bob up serenely at every Farmers' Institute and will be heard, and we listen, as we sadly reflect that death alone will end their chronic grumbling. We all know them, and we know just as well that their homes and farms prove that they have all the essentials, not for successful farming, but for fault finding, and when one by one they are gathered, still kicking, to their fathers, we heave a sigh of relief, and piously say, "The Lord's will be done."

And lastly, to round out our ideal farmer, he must be a close observer, have an eye to see and detect quickly, he must act wisely, must know how to buy and how to sell; must be a wide-awake, up-to-date business man; must shake off the dust and hay-seeds and get into the swim. He must look well to the minute details, for their name is legion, and he must keep an eye on the hired help, not solely that he may make them a source of profit to himself, but to keep them pure and wholesome and encourage and assist them to grow up self respecting, honorable and upright men and women.

It is just as hard to make a first class thrifty farmer out of a fool, as it is to make a genuine statesman out of a dude. The farm produces neither of these freaks, but is the best place in which to train up and give to the world, the men and women that it needs more than anything else. Cut off the influx of the sweet, true, strong and honest life that flows into the cities of the land for ten years, and there is not a single one from the metropolis down, but that would merit the doom of Sodom and Gomorrah. So let us all do what we can to produce everywhere the ideal farmer. May his tribe increase.

AGRICULTURAL CHEMISTRY IN THE NINETEENTH CENTURY.

BY DR. WILLIAM FREAR, *State College, Pa.*

Mr. President and Members of the State Board of Agriculture:

Instead of making at this time a presentation of facts or discussion of principles concerning some particular point in the domain of agricultural chemistry, as has been the usual practice on these occasions, it has occurred to me that at this opening of the new century, it might be of greater interest to briefly sketch the progress of agricultural chemistry during the century that has just closed.

The arts of metallurgy, pottery, glass-making, the manufacture of alcohol and of soaps had attained such development that, in a sense, man regarded himself as master of the elements, material and physical, as a result of whose operation, the several products of these arts were made. But no such conception of his relation to the productive forces of plants and animals occurred to the loftiest-minded agriculturist; his was the simpler, though possibly no less difficult, relation of the humble aid to natural forces; he planted the seed after such soil preparation as ages of experience had shown to be desirable for reasons yet undiscovered, awaited the action of the sun and the rain and the awakened energies of the plant and, at harvest time gathered into his garners such product as their beneficent action afforded. In turn, his vegetable products were fed to the domestic animals and this feeding, among the more intelligent farmers, was guided by certain crude rules that had grown out of experience, but that had no common tie of underlying reason. To-day, the attitude of the farmer, though possibly no less humble in spirit, is enlivened by a new sense of mastery over the forces and materials with which he works; so that though in a much less complete measure, he may, like the metallurgist, properly be regarded as a manufacturer in whose laboratories the plants and animals, skilled assistants endowed with particular powers and selected and trained by his intelligence, convert the materials which he furnishes in his soils and fertilizers by the aid of physical force, which the farmer more largely than ever controls, into specific products. That is, the farmer has attained by this time to a degree of controlling influence over the elements and results of his operations which a century ago he did not dream of reaching.

In a very large measure, this new attitude has been made possible by reason of the development of the science of chemistry, that science which deals with the fundamental nature of matter and its conversion from one form into another. In making this statement, I would not be understood as belittling the importance of those sciences which deal with the facts and underlying laws relating to the form, movement and vigor of the living agents, including not only the common crops and domestic animals, but the microscopic forms of matter upon whose aid the farmer is dependent for the attainment of his results. No theory of production which fails to take into account each of these classes of facts and sets of principles would offer a practicable method for use in the art of agriculture; but from the fact that the transformations effected on the farm and in the stable are essentially changes in the kind of matter, and since the realm of chemical force has been widely extended into the territory of plant and animal life, it may safely be asserted that the facts and principles in chemical science have exercised a preponderant influence in the agricultural scientific development of the nineteenth century.

At the beginning of this period, the reasons underlying agricultural operations in the field and the principles of feeding were scarcely more scientific than those which prevailed in the best days of Roman agriculture. The study of botany had resulted in a better knowledge of specific form of plants and the study of zoology, more recently developed, had led to a similar condition of information respecting the forms of animal life that were distinctly visible to the naked eye. The art of the horticulturist, with certain general rules governing the practice of the breeding of plants and the control of their development by the operations of grafting, etc., had led the florist, the fruit grower and, to somewhat less degree, the producer of field crops to a sense of some mastery over the form of his vegetable products; and at the close of the eighteenth century, the principles of heredity governing the form, vigor, special productive capacity and fixity of type among domestic animals had also come to be understood by a few of the more intelligent stockmen; but concerning the general nature and transformations of matter occurring in the soil and in plants and animals, almost nothing was known. Evidently no intelligent conception of this class of facts was possible until a correct fundamental theory of the chemical nature of matter and its changes had been developed and accepted; and it was not until the opening of the nineteenth century that the fundamental conceptions of the indestructibility of matter, and of weight as a permanent measure of mass were clearly stated and generally accepted. At this time, also, by general consent, the phenomena in plants and animals were ascribed to the action of the mysterious vital force, supposed to have little or nothing in common with the

forces governing the chemical changes of the mineral kingdom; and it was not until well on in the second quarter of this century, that the brilliant discoveries of Woehler, Berthellot and others had proven that from purely inorganic materials the formation of substances heretofore regarded as distinctly products of vital action, could be made by purely laboratory methods. The resulting change in the conception of the active forces governing the production of plant and animal materials may not have been essential to the final attainment of the facts now at our command, but did much to make investigations along these lines promising of fruitful result, and to this stimulus much of our present knowledge is doubtless due.

Possibly a better idea of the condition of knowledge upon the subject of agricultural chemistry may be had if we recall that at the beginning of the eighteenth century, scarcely fifty years had elapsed since the alchemist was spending most of his efforts in the attempt to discover the 'philosopher's stone' by which the transmutation of common substances into gold might be accomplished, or to the discovery of the 'elixir of life' whereby the ravages of age and disease might infallibly be overcome. While it is true that the Arabian physicians of the middle ages had separated quite a number of our common chemical principles, such as alcohol and cane sugar, the systematic methods of chemical research were exceedingly crude; the method of distillation by comparatively high heat was almost the only means used for the separation of chemical substances of organic origin during the first quarter of the eighteenth century. Better results attended the later application of mild solvents for the purpose of separating organic materials. The discovery of the chemical nature of gases and the perfecting of the chemical balance, so that quantitative analysis became possible, did not occur until the last half of the eighteenth century. It need, therefore, be matter for little surprise that the chemical and mineral differences between soils and their components was not fully understood one hundred years ago and that the information possessed concerning the readily decomposable constituents of plants and animals was of the crudest description. From this state of great ignorance, through a spirit of active and patient investigation, we have made considerable strides toward the attainment of the knowledge necessary to the complete mastery of our business.

Let us glance briefly at some of the fundamental achievements of our time and also strive to discern as well the limitations and failures in our work. By the application of new and refined methods, hundreds of substances, heretofore unknown, have been separated from plants and animals. The chemical constitution of most of them has been determined with more or less accuracy and, in many instances, the relation which

each bears to the productive activity of the plant. Possibly the development of sugar in the beet may be cited as that example which shows the highest measure of attainment of intelligent control on the part of the producer over the productive action of the plant. The relations of the air and soil, as sources of the raw materials from which plants are built up, have also been very carefully worked out. The means by which the carbonic acid of the air, and the water are brought into the plant and the transformations they undergo in the production of the principal portion by weight, of the plant and materials, have been, to a quite advanced degree, deciphered.

Concerning the mineral elements, our investigations have thus far been less productive of decisive results. Thousands of ash analyses have made clear what elements the plants take up and numerous painstaking water cultures have enabled us to select from these ash constituents those which are essential to the development of plants; but as yet, we know very little about the specific usefulness of any one of these ash constituents. Many attempts have been made to discover the powers of the several common species of farm plants to secure the necessary ash constituents from the several mineral materials of the soil. Some little insight has been gained, but the study has proven much more complex than at first anticipated and our present information upon this point is quite chaotic. We have, however, gained a much better conception of the means by which plants are able to take up mineral materials of the soil than was possessed in the year 1800. At that time, it was commonly supposed that plants actually had the power of taking in the fine solid particles in the solid form and utilizing them, while others held that only the humus of the soil was capable of acting as plant food. To-day, we know that most soluble substances in the soil can be taken up by the plant by the same kind of process by which cane sugar, spread over a dish of berries, passes through their outer skins and sweetens them. We know also that very many mineral substances, insoluble in water, can be taken into the plant rootlets, just as the sugar is taken into the berry, and it is also quite well established that an important part of the humus is likewise capable of being taken up by the plant roots. Half-way through the past century, it was confidently predicted that the chemical analysis of soils would soon enable us to determine, in connection with the facts established by the analysis of plants, precisely what kind and how much fertilizer would need to be applied to a given soil to produce, under fair conditions of weather, a crop of given quantity. But after fifty years of patient, painstaking investigations we seem to be little nearer that point than we were at their inception. This may seem strange, but if I say to you that the problem that the chemist confronts in this case is that of securing a solvent which will, in the

course of a few moments, extract from the soil precisely those kinds of compounds and in precisely the quantities which a growing crop will abstract in an ordinary season of growth, you will better comprehend his difficulties. Chemical analysis has enabled us to discover those cases where soils are exceedingly deficient in an available form of some one or more plant food constituents. The more refined methods have also, in a number of cases, enabled us to predict, with a fair degree of success, the action of certain classes of fertilizing materials upon them; but in this field much still remains to be done before the hoped for result is attained. The past century has seen the birth and the great development of the commercial fertilizer, a form of concentrated plant food, designed to supplement the available supply in the soil of some particular plant nutrient; and chemical investigation has done much to reduce the cost of the preparation of these fertilizers and to utilize in their manufacture a great deal of material which was heretofore wasted or lay neglected in the crust of the earth. It is quite possible now, as a result of these advances in fertilizer manufacture, to put into a soil whose texture fits it for the intensive culture of a high-priced crop, such as early truck, a very large proportion of the plant food which the plant requires and do this with economical results.

In the domain of animal life, the investigations of the agricultural chemist have brought us still nearer to a perfect control of the kind and amount of product, whether of milk or of meat; so that, to-day the practical farmer has accepted, because he has found them to be applicable to his practice, rules for the compounding of his rations that have been formulated on the basis of the investigations of the chemical laboratory upon the operations of the stable. Yet despite this very material advance, we note that much remains to be done in this field. Great numbers of plant substances are grouped under a few broad heads and treated as though their nutritive and dietetic effects were precisely the same. Investigations of recent years have done much to show that still finer distinctions should be drawn between the components of foods than has yet been done, and thousands of experiments must be made under more refined methods of operation before the scientific facts and their practical relations can be discovered and formulated.

The work of the chemist has, however, not stopped at this point, but much of his energy has been devoted to the improvement of the processes of harvesting, curing and storing of the vegetable products, and to the development of manufacturing processes which depend upon the products of the farm for their raw materials. The exact control now practiced in the manufacture of sugar by which the waste of nearly one-half the crystalline product in the cane that was prevalent fifty years ago, has been for the most part overcome; and it is due to such investigation that the more exact manufacture

of vinegar and other fermentation products have been made possible by the joint efforts of the chemist and the bacteriologist. The operations of the creamery, to-day, are alike a monument to mechanical and chemical genius; where twenty-five years ago, over one fourth of the milk fat was thrown to waste in the skimmed milk, and a large additional fraction was lost in the buttermilk, the losses of to-day's operations have been reduced to one-tenth of that which was common in 1875; the introduction of methods of chemical analysis to govern the exactness of operations of the new mechanical appliances for cream separation and churning has made this possible.

It may fairly be claimed, also, that a very large measure of that development of agricultural science in the fields of plant physiology, animal industry, veterinary science and general agricultural practice that has resulted from the work of investigators in those lines at the various agricultural experiment stations of the world, is due very largely to the stimulus which the study of chemical problems for the promotion of agriculture gave. The primary work of nearly all the experiment stations that have been established, and certainly that of the first stations established, has been chemical in nature. The mere fact that laboratories, where special appliances and peculiarly trained men are necessary for chemical research, made the establishment of such stations inevitable. Once established, the inauguration of parallel lines of investigation by the botanist, agriculturist, veterinarian and the bacteriologist naturally followed.

What work the next century shall see accomplished in agricultural chemistry, the boldest would scarce venture to predict. From the present standpoint the most pressing needs seems to be for investigation on five classes of subjects: First, the value of its several mineral constituents to the plant; second, the nature of the apparent selective power which plants manifest in the taking up of food materials from various mineral sources; third, the formulation of methods of analysis, by which the average selective action of a given crop upon the soil may be imitated in the laboratory for the purpose of affording, through analysis, the means of more precise determination of the specific crop-producing value of soils; fourth, the better separation of the several constituents of plants and, fifth, the determination of their respective food values to the animal.

FOOD AND ENERGY.

BY DR. HENRY PRENTISS ARMSBY, *Director of the Pennsylvania State College Agricultural Experiment Station, State College, Pa.*

Some at least of the members of the Board of Agriculture have probably heard more or less of a new apparatus which has been in process of construction at the State Experiment Station for the past two years. They are aware that this apparatus is designed for use in some way in experiments upon the nutrition of our domestic animals, and they have probably gathered that it is likely a very complicated and "scientific" piece of machinery and have perhaps asked themselves, "of what use can investigations made by such refined methods be to the ordinary practical farmer?" I have thought that it might be of some interest to the Board if I were to take this opportunity to explain, in a general way, the nature of the work to be carried on and the general methods employed, and to indicate what results of practical value are likely to be reached. I have felt the more inclined to do this because the question of the practical value of the researches is an eminently proper one. The Agricultural Experiment Stations are sustained by the public funds and the public is perfectly right in demanding that the work of the stations should have an *ultimate* practical aim. They are not at liberty to carry out purely scientific investigations simply for the sake of adding to the sum of human knowledge, without any reference to the practical value of that knowledge.

It must be remembered, however, that an experiment may be ultimately of the highest practical value, even when it does not lead to any *immediate* practical result. Some forty or fifty years ago, some of the leading agricultural scientists of Germany were spending a large amount of time and energy in growing a few plants of barley or corn or oats in solutions without the use of any soil whatever. Repeated experiments were required to determine just what conditions were most favorable for growing plants in this way, and much more time still was expended in finding out just what materials must be present in the solution, what ones might be omitted, and what ones were actually poisonous to the plant. To the practical farmer who visited their laboratories, this must have appeared very remote from the conditions of agricultural practice. One can hardly

imagine anything which seems more unpractical than for an experimenter to spend days and weeks in growing plants in solutions in pots. In the long run, however, these apparently unpractical experiments have proven themselves of the highest practical value and have done more to advance the practice of agriculture than ten times the same amount of time expended in ordinary "practical" field experiments. It is largely on the basis of those "theoretical," unpractical, water culture experiments that our present knowledge of the necessary ingredients of fertilizers and of their relations to plant growth is based and without these investigations into fundamental principles, we should still be groping in the dark in these subjects.

This is simply a single illustration of the general truth that investigation into the underlying general principles of any art or calling does more in the long run to advance its practical interests than any amount of empirical, "rule-of-thumb" work. We find that this same truth which has been so strikingly demonstrated in regard to plant nutrition applies also to animal nutrition, and that in the past those experiments and investigations which have been directed toward working out the fundamental principles upon which animal nutrition depends have had in the end the highest practical value. We believe that what has been true in the past will be true in the future and that if the Pennsylvania Experiment Station can contribute to a better understanding of how the food nourishes the body, it will in the end help the farmer to feed more profitably because more skillfully.

We all know from every day experience that when a man or animal is deprived of food, the body gradually wastes away and becomes incapable of performing its normal functions. In the past, we have been accustomed to regarding the food required by the animal largely as a supply of matter to make good this waste and loss from the body. At first, the food was looked at as a whole. Later students of the subject came to distinguish between the values of different kinds of food, and still later, to base their conclusions not merely upon the total amount of food consumed but upon the amounts of digestible substances it contained; and hence arose the various nutrition tables, feeding standards and the like. Of late years, however, we have been coming to regard the food not so much as a supply of matter to make good that lost from the body as in the light of a source of *energy* to the animal body. It is this view of the food as a source of energy which lies at the base of the experimental work which the station, in co-operation with the United States Department of Agriculture, is undertaking and which I purpose to explain briefly to-day.

In the first place, what do we mean by energy? We all know

that work does not do itself. When we go into a mill or factory and see some great machine at work, we know that the machine itself does not produce the power which we see exerted. If we examine more closely, we find perhaps a belt or gear connecting this machine with a shaft, and following this up still further, we find perhaps another belt until we finally come to the water wheel and discover that it is the pressure or the weight of the water in the reservoir behind the mill which is the source of the power exerted. When we stand beside the track and see a great locomotive go thundering by, we know that it is not the iron and steel of the machine which furnishes the power, but the steam in the cylinders, and that this in its turn owes its existence to the burning of the fuel under the boiler. When we see the trolley car go whizzing along the streets, we trace up mentally a similar but more complex chain and find, as in the locomotive, the ultimate source of the power exerted to be the fuel burning under the boilers in the power house. In all these cases, and in all instances where power is exerted, something does work. This something we call energy and we, therefore, define energy as being the *power of doing work* and speak of the energy of the falling water or of the burning coal.

Let us now take another step: Most of us have probably watched a pile driver at work. The heavy weight is drawn to the top of the machine and let go; as it falls, it gradually acquires an increasing velocity, and at the moment when it strikes the head of the pile it is able, by virtue of this velocity, to do work upon the pile. That is to say, the falling weight of the pile driver contains energy. After the weight has fallen, it is again drawn up to the top of the machine; in so doing, work is done upon the weight either by muscular energy or, more probably, by the energy of coal burning under a steam boiler. When the weight has been drawn up and fastened at the top of the frame, it contains the potentiality of doing work. So long as it remains there, it does not actually do any work, but that we have to do to get work out of it is to allow it to fall; in this sense, then, the weight at the top of the pile driver has the power of doing work and this is equivalent to saying that it contains energy. It is plainly, however, a different sort of energy for that which it had at the moment of striking the pile. We call it *potential* energy, meaning by this that it contains the possibility or potentiality of work. The energy which the weight contains when it strikes the top of the pile, on the other hand, we call actual energy or energy of motion or *kinetic* energy. A swinging pendulum affords a very good illustration of these two forms of energy and the conversion of the one into the other; when lifted to one side, it contains a certain amount of potential energy; when it reaches the middle of the swing, that energy has been converted into kinetic energy; as it rises this

kinetic energy or energy of motion is used to do work upon the pendulum; at the other extremity of the swing all the actual energy has been converted back into potential energy and so the alternate conversion goes on as long as the pendulum swings. In the case of the mill, the water in the reservoir contains potential energy due to its position; as long as the water stands in the reservoir, it does not actually do any work, but it contains the possibility of doing work. When the gate is opened and it begins to set the wheel in motion, this potential energy, or energy of position, becomes converted into energy of motion or kinetic energy. In the case of the burning coal under the boiler, the coal itself, as long as it does not burn, does no work, but it has stored up within it the possibility of doing work; that is, it contains potential energy. When it burns, this potential energy or latent energy becomes actual or kinetic in the form of heat and this heat in its turn gives rise to the various other forms of energy such as that of the expanding steam, the moving engine, the electric current, the moving trolley, etc.

What I have just said suggests another important fact regarding energy, namely, its capacity for taking varying forms. The case of the electric plant is perhaps as good an illustration as any. Here we ordinarily start either with the potential energy of coal or the potential energy of water in an elevated reservoir. The potential energy of the coal by the process of combustion is converted into the actual or kinetic energy of heat; some of this heat escapes, but a part of it is used in forcing the particles of the water in the boiler further apart and converting them into steam. The steam thus produced, therefore, contains potential energy; that is, a part of the potential energy of the coal has now taken the form of the potential energy of steam. In the engine this steam expands and moves the piston from one end of the cylinder to the other, thus setting the engine in motion; in this process the potential energy of the steam, derived from the heat of the fire, is again converted into the actual or kinetic form of visible motion. In the dynamo, this energy is changed from the form of motion to that of electricity and in this form passes out over the conducting wires. Following it up still further, a part of this energy is perhaps used in driving a trolley car or a motor and thus finally takes the form of visible motion; another part of it is perhaps employed in an electric lamp, producing heat and light, while still a third may be used to produce chemical changes in the vats of an electro-plater, while by proper apparatus a portion of the heat radiating from the electric lamp may be re-converted into electricity and start on another cycle of change. Still further, the light from the electric lamp falling on the green leaves of a plant may take the place of sunlight and expend its energy in building up the tissues of the plant, finally producing some-

thing analogous to the coal with which we started and containing energy in the potential form. In a general way we may say that it is theoretically possible to convert any form of energy into any other form.

One more very important fact regarding energy remains to be noted. In all these changes and transformations, no energy is destroyed. Energy, like matter, is indestructible. Take again the case of the pile driver; when the weight is raised, a definite amount of energy is expended in raising it and becomes potential in the weight. When the weight falls back to its original position, it gives out exactly the same amount of energy which was imparted to it when it was raised. In the swinging pendulum, the kinetic energy at the lowest point is exactly equal to the potential energy at the highest point and to the sum of the two at any intermediate point. The potential energy of the water in the reservoir is represented exactly by the amount of work which it took to raise that water to the level which it has acquired, and it gives out exactly this amount of energy in falling again to its original level. In the case of the coal, it took exactly the same amount of energy in the sun's rays in the carboniferous period to build up the organic substances of which the coal is composed which is given off in the form of heat when that same coal is burned. Any exceptions to this law of the *conservation of energy* are only apparent and the more carefully we trace up the track which the energy takes the more fully do we find it accounted for.

Thus far we have been dealing in general principles and with facts which seem somewhat remote from the particular subject of this paper. Let us come now to the application of them to the problems of animal nutrition.

Bearing in mind the facts already stated, whenever we see work being done, we shall look for the energy which accomplishes it and shall expect to see the principles which have just been expounded hold true. When we look out on a crowded city street, we see in the aggregate a very large amount of work being done by men and animals. Whence comes the energy which accomplishes this work? It comes, in the first place, as it does in the case of the steam engine, from a combustion. Every animal is constantly giving off substantially the same products of combustion which are given off from the chimney of the steam plant or the stack of the locomotive, namely, carbonic acid and water. The analogy of animal respiration to combustion was first pointed out by Lavoisier, the French discover of oxygen, who first supposed that this combustion took place in the lungs of the animal, which he compared to a furnace. Later, however, he adopted the view which is now universally held, that this combustion takes place throughout the tissues of the liv-

ing animal is constantly burning up its own tissues and it is the energy set free in this burning which enables it to do work, including both the visible external work which we can see and also the internal work required by the beating of the heart, the movements of respiration and the various activities of the internal organs. As we know, all these external and internal activities may go on for a time in an animal deprived of food and we, therefore, conclude that they are at the expense of the burning of tissue. Indirectly, however, all this energy is derived from the food of the animal, since it is the food which supplies the material for building up the body tissue. We may again recur to the illustration of the reservoir. Its potential energy, that is, its power of doing work, lies in the fact that it contains a considerable amount of water at a certain level, just as the body of the animal contains a considerable amount of potential energy in the form of tissue which can be burned. If we are to make continuous use of the reservoir, we must have a stream of water running into it as well as a stream running out. It is this inflowing water which corresponds to the food of the animal, and just as the potential energy of the reservoir is supplied ultimately by the water which runs in at the upper end so the energy which the animal is able to exert is derived ultimately from its food. This is what is meant by stating that the food of the animal is a source of energy. It is the inflowing stream which keeps up a store of potential energy in the body, and just as the work that can be done by the mill depends in the long run upon the rate at which water runs into the reservoir, so in the body, the amount of work that can be done depends upon the supply of energy in the food. In other words, the question is one of the balance between the income and expenditure of the energy of the body.

Looking at the matter in this light, let us take up a little more in detail the items making up the income and the expenditure of energy by the animal organism.

As just stated, the food constitutes the income of energy. It is a fact of common observation, however, as well as established on a quantitative basis by large numbers of experiments, that only a portion of the material actually eaten is really available for the purposes of the body. In the case of our common domestic animals, in particular, a relatively large proportion of the food is not food at all in the true sense, but simply ballast which passes through the animal unacted upon. To carry out still further our illustration of the water in the reservoir, the case is as if the inflowing stream of water were muddy and had to be filtered or run through a settling basin before being admitted to the reservoir. The mud thus removed from the water would correspond to the excreta of the animal, while the pure water would represent that portion of the food which actually

enters into the structure of the body and serves as a source of energy. But this process of digestion and assimilation by which the available material of the food is separated from the unavailable and converted into tissue constitutes work and consumes a portion of the energy of the food. The case is not like that of a boiler fired by a mechanical stoker, the power to drive which is derived ultimately from the combustion of the very coal which it feeds into the boiler, or to still continue the illustration of the reservoir, it is as if the water instead of flowing into the reservoir was pumped up to it by a hydraulic ram actuated by apart of the same water. This matter of the amount of work expended in digesting and assimilating the food is one which recent investigations have shown to be of great importance and to have a very material bearing upon the relative values of foods. Obviously a food like corn, for example, which requires comparatively little digestive work will, other things being equal, be of more value to the body than a food like straw whose digestion involves a large amount of work.

A portion of the food energy, then, is expended in the work of digestion and assimilation and is, therefore, to be deducted from the total energy of the food before we can find how much is available for other purposes. The remainder we may call available energy. It is used in part for the internal work of the body, such as the beating of the heart, the work of respiration and a great variety of other processes going on in the body, and in part for the visible external work; that is the useful work which the animal performs. Finally, if the energy of the food is in excess of all these requirement—if more water is running into the reservoir than is required to keep the mill running—the excess is stored up in the body as growth of tissue, chiefly of fat, to be used later when the supply of food may be insufficient;—the level of the water in the reservoir rises.

In order then to know how different feeding stuffs and rations compare with each other as to their value as sources of energy to the animal, we need to know, first, the total amount of energy which they contain; second, the amount which needs to be deducted from this for materials of the food which are unavailable to the body; and third, the amount of work required for the digestion and assimilation of the food. Furthermore, we need to know how the amount of enery which is actually available from a feeding stuff for ordinary purposes is affected by the conditions under which it is fed. For example, whether large and small amounts of the same feed have the same degree of availability; whether the availability is affected by the temperature of the stable, by the amount of water consumed, by the age and state of fatness of the animal and other conditions which might be named. It is this sort of information which it is expected to obtain by the experiments with the respiration-calorimeter. The

general idea of the experiments is to keep a sort of debit and credit account with the animal. The animal is charged with the potential energy of the food which it consumes; this is measured by burning a small sample of the food under such conditions that all the heat produced can be collected and measured; this heat gives us the measure of the total potential energy of the food. On the other side of the account, the animal is to be credited first, with the potential energy of those portions of the food which are not burned up in the body, but pass into the excreta. This corresponds to the mud filtered out of the water in our illustration of the reservoir or it may be compared to the ashes and flue gases of the furnace in which coal is burned. Second, the animal is credited with the heat which it gives off. It is this heat which it is one of the prime purposes of the respiration-calorimeter to measure and the most complicated and delicate portion of the apparatus is that devoted to the accurate measurement of the amount of heat produced by the animal. Third, the animal is credited with the energy of any work which it may perform, although in our own experiments, this factor we will for the present not enter in. Comparing now the amounts on the two sides of the account, if the debit side is larger than the credit; that is, if the animal has received more energy than it has given off, there has been a storage of energy in the form of a gain of flesh or fat which should be entered on the credit side of the account to balance it, while, on the other hand, if the credit side is the larger, there has been a loss in the energy of the body showing that the animal has been living in part on its own tissues.

The amount of energy gained by the animal upon a given food gives us the clue to the determination of the availability of the energy of that food. Suppose, for example, that we put a steer upon a ration which is exactly sufficient to maintain it; that is, which supplies just enough available energy to keep up the internal work of the body, and upon which there is consequently no gain or loss of tissue or of energy by the body—in which the inflow to the reservoir exactly equals the outflow. Now, suppose we add to this ration enough of the particular feeding stuff under experiment to furnish to the body 1,000 units of energy. Suppose further that our trial in the respiration-calorimeter shows us that out of these 1,000 units of added energy, 600 units are added to the heat production of the body and 400 units stored up in the form of gain of fat and flesh. It is evident that the availability of this particular feeding stuff, under the conditions of the experiments, is 40 per cent. that is, 40 per cent. of its energy can be stored up in the body while 60 per cent. is consumed in the work of digesting and assimilating the food and simply serves to increase the heat given off from the body. Let us suppose now that we repeat the experiment with another feeding stuff.

giving as before an amount containing just 1,000 units of energy, and that in this experiment, we find that the production of heat is increased by only 400 units, while the gain of tissue is equal to 600 units; in this case, the availability is plainly 60 per cent. while only 40 per cent. is required for digestion and assimilation. In other words, a given number of units of energy in the second feeding stuff is worth one and one half times as much for growth or fattening as the same number of units of energy in the first feeding stuff.

In the above illustrations, round numbers have purposely been used to illustrate the principle. Let us now turn for a further illustration to the results of actual experiments and consider some recent German results, obtained by a slightly different method but having substantially the same significance. After making a deduction for the energy of the indigestible matter, it was found that one gram of the digestible matter from the following feeding stuffs contained the amounts of total energy shown in the first column. Of this energy, the quality shown in the second column served simply to increase the heat production of the animal, while the remainder, as stated in the third column, was available for tissue-production. While of this the amounts shown in the second column were available for tissue production. Finally, by dividing the third column by the first, we compute the percentage availability of the energy of these different materials.

	Total energy.	Used to produce heat.	Available energy.	Percentage availability.
Peanut oil,	8,821 Cal.	3,855 Cal.	4,966 Cal.	56.3
Meadow hay,	3,643 Cal.	2,131 Cal.	1,512 Cal.	41.5
Oat straw,	3,757 Cal.	2,348 Cal.	1,409 Cal.	37.6
Wheat straw,	3,326 Cal.	2,734 Cal.	592 Cal.	17.8

As yet comparatively few feeding stuffs have been investigated in this way while we are but just beginning to sketch out the general laws governing the availability of feeding stuffs. The much discussed question of the nutritive value of the woody fiber of food is a good illustration of this. The earlier writers on stock feeding considered it to have no value whatever. Then came experiments which showed that a large proportion of it was apparently digestible by ruminants, and on chemical evidence the digestible portion was assumed to have substantially the same nutritive value as starch or sugar. Still later, it was shown that much at least of its

apparent digestibility was due to an extensive fermentation which it underwent in the digestive apparatus, and on the basis of these results serious doubts were again raised as to its nutritive value. More recently still, since the question of the expenditure of work in digestion has been brought prominently forward, one noted investigator claims to have shown that in the horse all the energy of the digested crude fibre is consumed in its own digestion; that is, the fuel is so poor that it takes all the steam it can make to run the mechanical stoker. On the other hand, another equally distinguished investigator seems to have shown that some forms of crude fibre when fed to ruminants are about as valuable sources of energy as pure starch.

I mention these fluctuations and divergences of opinion simply as a striking illustration of the paucity of our present knowledge in this field. If it be true, as it unquestionably is,that food is to be regarded primarily as a source of energy to the animal organism, it is certain that before we can put the practice of stock feeding upon a sound scientific basis we must know much more than we do now about the amount of energy contained in different feeding stuffs, about the relative availability of this energy and as to how its availability is or may be increased or diminished by the conditions of the feeding. It is the hope of the Pennsylvania Station to be able to contribute something towards the enlargement of our knowledge in these particulars. As I urged at the outset, while the work is primarily scientific in its character, it is yet, as we believe, also practical because it is directed toward the laying of secure scientific foundations upon which a rational practice may be built.

COMPARISON OF TEMPERATURE AND RAINFALL OF 1900 WITH RECORDS OF PREVIOUS YEARS.

BY E. R. DEMAIN, *Observer, Weather Bureau, Harrisburg, Pa.*

A comparison of some of the weather conditions prevailing at Harrisburg during the year 1900 with the record of former years, discloses several features of interest. In order to show clearly the principal points of difference the following table is presented:

Year.	Temperature. Mean.	Highest.	Lowest.	Rainfall.
1889,	51.8	92	—1	57.07
1890,	52.4	96	8	42.63
1891,	52.6	93	10	43.40
1892,	51.[illegible]	98	8	39.65
1893,	50.4	96	—4	35.18
1894,	52.9	96	3	40.56
1895,	51.2	97	—4	26.02
1896,	52.3	95	—1	35.06
1897,	52.8	95	4	33.66
1898,	53.6	101	6	45.09
1899,	52.2	95	—13	33.98
1900,	54.3	100	3	28.94
Average,	52.2	....	....	38.44

An examination of this table will show that 1900 was the warmest year since the Weather Bureau station was established in the city. The mean or average temperature for the year was 54.3 degrees, which is 2.1 degrees above the average for 12 years and 0.7 degrees higher than the average for 1898, which ranks second in point of heat; the coldest year was 1893 with an average of 50.4 degrees or 3.9 degrees lower than the record for 1900. The departure in temperature values during the first half of the year was comparatively slight, the excess being about 0.7 degrees. During the months of February, March and December there was a deficiency in temperature. The great excess in temperature for the year was due largely to the long periods of heat which prevailed at short intervals during the months of July to November, inclusive, and especially to extraordinarily high temperatures of October which was decidedly the warmest October since the beginning of observations by the Weather Bureau, the average for the month being 60.6 degrees or 6.9 degrees above the normal October temperature. The highest temperature of the year was 100 degrees on July 17. This record has been ex-

ceeded but once in the history of the station, the highest point ever touched by the mercury being 101 degrees on July 3, 1898. The lowest temperature registered during 1900 was 3 degrees on February 25; this record has been exceeded a number of times in former years, the lowest point ever touched being 13 degrees below zero on February 10, 1899.

The total precipitation for the year 1900, 28.91 inches, is with one exception, the least annual amount ever recorded at the station and is 9.50 inches below the average for 12 years. The least amount measured during any year was 26.02 inches in 1895 and the greatest, 57.07 inches in 1889. The average amount for the twelve years the station has been in operation is 38.41 inches. The year 1900 goes on record as the warmest and, with one exception, the dryest since the beginning of regular observations at Harrisburg.

ANNUAL METEOROLOGICAL SUMMARY AT HARRISBURG, PA., FOR THE YEAR ENDING DECEMBER 31, 1900.

MONTH.	PRESSURE.			TEMPERATURE.							MOISTURE.										
		Extremes.		Mean.					Extremes.		Dew Point.		Relative Humidity.		Vapor Pressure.		Precipitation.		Cloudiness.		
	Monthly mean.* (a)	Maximum. (a)	Minimum. (a)	8 a. m. (b)	8 p. m. (b)	Maximum. (b)	Minimum. (b)	Monthly. (b).	Maximum. (c)	Minimum. (c)	8 a. m. (c)	8 p. m. (c)	8 a. m. (c)	8 p. m. (c)	8 a. m. (d)	8 p. m. (d)	Total.	Maximum in 24 hours	8 a. m. (b)	8 p. m. (b)	Daylight. (b) (e)
	In.	In.	In.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg	Deg	Deg.	Deg.	Per cent.	Per cent.	In.	In.	In.	In.			
January,	29.70	30.14	28.92	28.5	......	39.0	25.4	32.2	56	7	20	......	70	......	.118	......	2.07	.79	6.5	......	6.6
February,	29.63	30.20	28.84	26.0	......	36.3	22.6	29.4	53	3	15	......	63	......	.101	......	3.40	1.08	5.9	......	6.4
March,	29.65	30.18	28.96	31.2	......	41.7	27.1	34.4	53	5	19	......	60	......	.110	......	3.00	1.33	6.9	......	5.9
April,	29.66	30.01	29.24	48.1	......	61.9	43.9	52.9	81	28	33	......	57	......	.201	......	1.43	.39	6.0	......	5.4
May,	29.61	29.96	29.09	58.2	......	73.4	51.7	62.6	92	38	45	......	64	......	.326	......	1.33	.77	4.9	......	5.3
June,	29.60	29.78	29.37	68.8	......	81.4	62.9	72.2	92	54	57	......	68	......	.482	......	2.88	.72	5.8	......	6.0
July,	29.62	29.82	29.24	74.2	......	88.0	68.1	78.0	100	57	61	......	66	......	.565	......	3.14	1.86	4.2	......	4.8
August,	29.67	29.90	29.55	73.7	......	88.3	68.2	78.2	98	57	64	......	73	......	.603	......	4.72	1.67	3.7	......	3.7
September,	29.72	29.95	29.28	66.6	......	79.4	62.3	70.8	92	44	58	......	74	......	.501	......	1.41	.80	5.7	......	5.0
October,	29.81	30.07	29.49	56.1	......	68.5	52.8	60.6	88	32	50	......	81	......	.394	......	1.25	.91	5.5	......	5.6
November,	29.67	30.20	28.94	43.3	......	52.7	39.4	46.0	74	24	35	......	73	......	.219	......	2.69	1.66	8.1	......	6.7
December,	29.72	30.10	29.30	30.2	......	40.1	27.9	34.0	54	12	23	......	68	......	.126	......	1.62	1.17	5.9	......	5.9
Year,	29.67	30.20	28.84	50.4	......	62.6	46.0	54.3	100	3	40	......	68	......	.312	......	28.94	1.86	5.8	......	5.6

*One observation daily at 8 a. m. (a) To hundredths. (b) To tenths.
(c) To whole numbers. (d) To thousandths. (e) To be taken from columnheaded "Monthly," Form No. 1002.

ANNUAL METEOROLOGICAL SUMMARY AT HARRISBURG, PA., FOR THE YEAR ENDING DECEMBER 31, 1900.

MONTH.	WIND.													NUMBER OF DAYS.										
	By Self-Register.					Number of Winds, 8 a. m.											Precipitation.				Maximum Temperature.			
	Average hourly velocity. (m. p. h.)	*Prevailing direction.	Maximum velocity. (m. p. h.)	Direction at time of maximum velocity.	Number of days with gales.	North.	Northeast.	East.	Southeast.	South.	Southwest.	West.	Northwest.	Clear.	Partly cloudy.	Cloudy.	.01 inch and over.	.04 inch and over.	Snow.	Fog.	Below 32°.	Above 90°.	Minimum temperature below 32°.	Thunderstorm—electrical.
January,	8.3	W	48	W	1	1	5	4	3	2	3	8	5	6	10	15	12	8	2	2	7	......	23	......
February,	10.6	W	40	W	2	1	3	6	1	3	2	6	6	7	5	16	12	9	4	2	9	......	21	......
March,	9.3	W	40	W	1	3	6	2	3	......	3	7	7	9	8	14	12	7	7	......	3	......	21	......
April,	7.9	W	30	W	......	4	3	2	2	1	1	9	8	11	8	11	9	6	1	......	......	......	2	1
May,	7.3	W	30	W	......	4	4	4	1	2	5	8	3	13	5	13	6	6	......	......	......	1	......	2
June,	6.5	W	30	W	......	3	5	2	4	2	6	4	4	8	10	12	12	9	......	......	......	3	......	7
July,	6.1	W	39	SW	......	2	2	1	4	3	6	11	2	10	16	5	11	9	......	......	......	11	......	10
August,	4.6	NW	33	W	......	6	4	2	2	1	2	7	7	14	12	5	9	8	......	1	......	15	......	5
September,	5.3	NE	31	W	......	6	6	5	1	2	1	5	4	11	10	9	6	6	......	......	......	2	......	1
October,	6.1	E	27	W	......	6	4	5	5	1	3	5	2	12	6	13	9	6	......	1	......	......	1	......
November,	8.0	W	48	W	2	2	3	5	......	2	6	10	2	4	11	15	11	8	1	......	......	......	4	......
December,	7.2	W	36	W	......	3	1	1	3	3	1	12	7	9	7	15	6	5	1	2	5	......	22	......
Year,	7.3	W	48	W	6	41	46	39	29	22	39	92	57	114	108	143	115	87	16	8	24	32	94	26

*By eye observations when there is no self-register at station. C.—Calm.

E. R. DEMAIN,
Observer, Weather Bureau.

MODERN CATTLE FOODS AND CATTLE FOOD CONTROLS.

BY DR. WM. FREAR, *State College, Pa.*

In all lines of human activity, the tendency of scientific development has been toward the preparation of a greater variety of products and toward the application to useful purposes of materials that formerly were regarded as of no possible use. This tendency has been manifested in the manufacture of cattle foods as well as in every other productive industry. The preparation of breakfast foods and the great variety of other special forms of human food, the manufacture of glucose and of starch, of beer, whiskey and alcohol have all resulted in the formation of a series of by-products which have sought the market as cattle foods. The conditions of animal industry have, on the other hand, created a demand for special foods supplying one or the other of the important groups of plant nutrients in large degree. Particularly it is true that the farmer of to-day demands, to supplement the feeding stuff raised on the farm, such cattle foods as will supply large quantities of protein.

This is due partly to the better recognition of the special needs of animals producing large quantities of nitrogenous tissue or of such a secretion as milk. It is also in part due to the attempt on the part of the dairyman and feeder to supply a fresh product the year round, and to the fact that the acreage required for the pasturage of cattle has, in the more thickly settled districts, become relatively too valuable to make stock-raising and dairying profitable by that method of feeding. One other fact in this connection is worthy of mention, namely, that the relative importance of corn and its stalks among the crops grown on our farms, coupled with the fact that the proportion of protein that these contain is far below that necessary for rations best adapted for the feeding of growing, muscle-producing and milk-yielding animals, has necessarily resulted in a deficiency of the protein supply in our home-produced cattled foods.

The eastern farmer no longer, therefore, relies chiefly upon pasturage for the maintenance of his animals during their most productive months, and upon his stock of hay, corn stover, corn chop, varied

by the use of a few oats and by the bran he brings from the mill as a by-product from the milling or his own wheat. All winter long, his animals are made to produce, because market prices are then the best. The process of intensive culture has somewhat reduced the permanent hay meadows, and for roughage, he relies much more on corn silage. Latterly, there has been a wise movement towards the growing of more nitrogenous roughage on our dairy farms, better attention being paid to the clover crop, and other legumes, such as cow peas, being introduced. The net result of these changes of condition, however, is that we are using to-day, more than ever before, large quantities of one sort or another of commercial by-products.

The conditions of food manufacture have also changed and these by-products are no longer made chiefly at our country mills by neighbors of whose honesty we are assured and into whose methods of manufacture we can readily examine. Our concentrated feeding stuffs coming instead, from distant sources, are distributed through the jobbers in large cities and often under peculiar trade names, affording no information whatever concerning the kind of materials of which these foods are composed or their richness in the valuable nutrients. That fraud should appear under such conditions, whether by the substitution of valueless materials for valuable, or by simple misrepresentation of the richness of a food product in protein or fat, is not a matter for surprise.

Concerning the variety of feeding stuffs, let us note that wheat no longer yields us simply bran and middlings, but we have upon the market bran, middlings, shorts, red-dog flour, ship stuff and mixed wheat feeds, and in addition, ground screenings; and each of these classes are sub-divided according to the kind of wheat from which it was produced, whether the hard spring wheat of the north-west or the softer varieties grown in other portions of the country. Rye, likewise, affords a similar series of products, though less numerous. From corn are produced not simply corn meal, but corn bran, gluten meal and gluten feed, and sugar feed from the manufacture of glucose; hominy chop and hominy meal from the manufacture of breakfast hominy, and cerealine and starch feeds from the manufacture of other corn products; in most cases each of these is subject to a greater or less extraction of the corn oil, with a resulting variation in composition. The oil-producing seeds, cotton and flax, are likewise subject to a greater variety of treatment with resulting differences of classification of product. What is true of the previously mentioned cereal grains is also true of oats. Our extensive brewing industries yield malt sprouts; the spent malt formerly hauled out from the little brewery in a moist condition, is now pressed, kiln-dried and sold wherever railroads penetrate. Distiller's grains, composed not simply of rye or corn, but of various mixtures of starch-

containing substances mixed with malt, likewise furnish a kiln-dried product of highly varied composition, according to the kind of alcohol-producing material used; and from our abattoirs come blood-meal, beef scrap and flesh meal, while dried; fine ground fish also appeared upon the cattle food market. That a cattle feeder might easily be bewildered in determining which of these many articles sold at widely varying prices he should select for his use in order that he may obtain the best and most economical result, is not strange.

In addition to the great variety of products resulting from such legitimate and praise-worthy efforts to find economical uses for waste products, the difficulties of the consumer are still further increased by the fact that adulteration of cattle foods is not at all an uncommon practice, though it has been much less frequently reported in America than in Europe. There are, nevertheless, a good many instances on record in which cotton hulls have been unduly admixed with cotton-seed meal, in which oat chaff has appeared in excess of its proper preparation in its chop, and in which the proportion of corn bran in gluten feed has been somewhat excessive. In New England, within two or three years, the discovery of admixture of ground corn cobs with brans imported from the middle western States was made. Since the contents of the dust bin of the flouring mills are now used in the manufacture of feeding stuffs for cattle, the casual sale of such materials under the names of those of better quality is to be anticipated. In Europe, where the pressed cakes of a great variety of seeds used in the manufacture of vegetable oils are employed for feeding purposes, the substitution of the cheaper for the more expensive is a matter of quite common occurrence; even castor pomace, which is poisonous to cattle, is sometimes introduced and the presence of saw dust has been noted; while the occurrence of cockle, darnel and ergot, as well as other poison-containing materials, is a matter of no infrequent occurrence.

The need for systematic examination of commercial concentrated feeding stuffs was recognized in the thickly populated countries of Europe early in the past century and one of the avowed objects of the establishment of the first German Experiment Station at Moeckern in 1851 was the investigation of such materials. These early stations in Germany were established, it is of interest to recall, by agricultural societies. The work in this direction has grown to such a degree that there are to-day, in Germany alone, about thirty stations engaged in the work of cattle food control.

In England, the Royal Agricultural Society employed a chemist to make similar investigations.

In America, some sporadic work of this kind was done by the experiment stations at the very outstart of their history, but the first legislation providing for continuous systematic work in this line was

enacted in Massachusetts, March 5, 1897; this was quickly followed by another act of the State of Maine taking effect October 1, 1897. Since then laws establishing cattle food controls have been enacted by Rhode Island, March 23, 1899; New York, May 3, 1899; Connecticut, June 20, 1899, and New Jersey, March 15, 1900.

In Massachusetts, publication is the only penalty for infraction of the law, except as private suits of the interested parties may result in the recovery of damages; but in the other States, in addition to publication there are imposed specific penalties of fine for failure to comply with the requirement to affix certain specified forms of brands upon the packages in which the feeding stuff is offered for sale, for failure to pay the taxes or license fees imposed, or for adulteration of a feeding stuff.

The results of this control, brief as the time of its operation has been, are very apparent in the exclusion of many undesirable materials from the market and a general improvement of the character of even the better classes of goods; at the same time the tendency is toward their more intelligent use by the consumer with more economical results in feeding.

An examination of the brans sold in Pennsylvania was, sometime since, made by the Experiment Station and recently the station has made for the State Department of Agriculture an examination of a large number of the various cattle foods sold in the State. Some of the results of this examination may be stated in this connection, and the details will shortly appear in a bulletin now in the course of preparation for the Department (Bulletin No. 81). The results show quite a wide range of composition in the ordinary, simple staple products; this, in the case of cotton-seed meal, the highest percentage of fat is nearly one-half greater than the lowest; and in linseed meal over twice as great, while in the protein also of the latter, the highest percentage is two and one-half times as great as the lowest; in the case of wheat brans, taking both winter and spring wheats into consideration, the highest percentage for protein is about one-fifth greater than the least; as wide a range is shown in the wheat feeds; in even the case of corn chop, the highest figure for protein is over one-half greater than the lowest and for fat over three times as great as the lowest; the gluten feeds range from nearly 14 to 27 per cent. protein and the oats feeds from 6 per cent. to 11 per cent. These figures suffice to show the uncertainty at present attending the purchase of cattle foods in this State and the utter impossibility, in the absence of carefully guarded guarantees, of an accurate compounding of the rations unless the consumer himself goes to the expense of analysis.

Another ground for declaring the need for such control is found in a comparison of the average quality of the goods sold

in Pennsylvania, as established by the recent analyses, with that of similar goods sold in New England since the enactment of cattle food laws. Such comparison of the principal concentrated feeding stuffs shows that, almost without exception, the goods sold in New England are superior in the amounts of most valuable constituents contained to those sold in Pennsylvania. In the case of gluten feed, for example, the average figures for Pennsylvania are 24.72 per cent. protein, 2.84 per cent. fat; in New England, 29.68 per cent. protein, 3.74 per cent. fat, though this is probably the most extreme divergence shown by the comparison.

Summarily stated, the object of such legislation is to establish State machinery for the examination of such cattle foods as are commonly sold through the jobber and are subject to material alteration of a nature not easily detected by the consumer without, on the other hand, embarrassing the trade too greatly and, so far as practicable, without placing undue burdens upon the small manufacturer.

To attain these ends, it is probable that, for the sake of the country miller, whole grains, chops and meals prepared from pure unmixed grains, and possibly unmixed bran and middlings sold directly from the manufacturer to the consumer, should be exempt from the requirement of affixing a brand containing a guaranty of composition; but certainly all other concentrated foods should be sold only under a guaranty of their protein and fat content. The brand should also state the trade name of the article sold, the quantity contained in the package, and the name and address of the manufacturer. It should also secure to the officers of the control the right of examination of all commercial concentrated cattle foods, so that such as are exempt from the brand and guarantee requirements for reasons just stated, may from time to time be tested as to purity. In order to prevent any infraction of the law, I believe that publication is in most instances sufficient, but there are cases in which the danger of a somewhat severe penalty alone will act as a deterrent, and the control officers should, therefore, be able to secure, whenever in their judgment it is necessary, the infliction of such penalty from guilty parties, the deliberate adulteration of a cattle food or misbranding should be as heavily punished as a simple failure to sell goods of the quality guaranteed; though the crime of adulteration is visited in neighboring States with a somewhat smaller penalty than that which it attaches to the failure to properly brand the goods or live up, in point of quality, to the guarantee. There are many points of interest in connection with the methods of maintaining and officering such controls in our neighboring States, but I will not at this time attempt a discussion of such details. The enactment of a food control law for Pennsylvania is now being discussed in several interested quarters. Each detail of such a law should receive careful consideration, but I

am satisfied that the agricultural interests of this State, especially those concerned with dairying and cattle feeding, will be materially benefited by this legislation and also that the country miller will share in the benefits resulting from such a law, because many of the imported materials with which he must not complete, will be obliged to stand distinctly upon their own merits rather than upon the very generous claims made for them by those interested in their sale*

*Note.—A law on the regulation of concentrated feeding stuffs was enacted at the last session of the Legislature and is found on page 651 of this report, in connection with an article which was published as Bulletin No. 81. See page 559.

COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

TABULATED ANALYSES

OF

COMMERCIAL FERTILIZERS

FROM

SAMPLES SELECTED IN ACCORDANCE WITH ACT OF JUNE 28, 1879,

BY THE

Pennsylvania Department of Agriculture,

FROM JANUARY 1, 1901, TO DECEMBER 31, 1901.

AN ACT

To regulate the manufacture and sale of commercial fertilizers.

Section 1. Be it enacted, &c., That every package of commercial fertilizer sold, offered, or exposed for sale, for manurial purposes, within this Commonwealth, shall have plainly stamped thereon the name of the manufacturer, the place of manufacture, the net weight of its contents, and an analysis stating the percentage therein contained of nitrogen in an available form, of potash soluble in water, of soluble and reverted phosphoric acid and of insoluble phosphoric acid: Provided, That any commercial fertilizer sold, offered, or exposed for sale, which shall contain none of the above named constituents shall be exempt from the provisions of this act.

Section 2. That every manufacturer or importer of commercial fertilizers as specified in section one of this act shall, on or before the first day of January next ensuing, or before offering them for sale in this Commonwealth, file annually with the Secretary of Agriculture an affidavit showing the amount of said fertilizer sold within the Commonwealth during the last preceding year; and if the said amount shall be one hundred tons or less, he shall pay to the Treasurer of the State the sum of fifteen dollars for each and every brand of such commercial fertilizer sold within the State during the last preceding year; and if the said amount shall exceed one hundred tons, and be less than five hundred tons, he or they shall pay the sum of twenty dollars, as aforesaid; and if the said amount shall be five hundred tons or more, he or they shall pay the sum of thirty dollars, as aforesaid. If such manufacturer or manufacturers, importer or importers, shall not have made any sales within the Commonwealth during the preceding year, he or they shall pay the sum of fifteen dollars, as aforesaid. Every said manufacturer shall, at the same time, file with the Secretary of Agriculture a copy of the analysis required by section one of this act, and shall then be entitled to receive from the Secretary of Agriculture a certificate showing that the provisions of this act have been complied with.

Section 3. The Secretary of Agriculture is hereby empowered to collect samples of commercial fertilizers, either in person or by his duly qualified agent or representative, and to have them analyzed, and to publish the results for the information of the public.

Section 4. The Secretary of Agriculture, and such assistants, agents, experts, chemists, detectives and counsel as he shall duly au-

thorize for the purpose, shall have full access, ingress and egress to all places of business, factories, farms, buildings, carriages, cars and vessels, used in the manufacture, transportation or sale of any commercial fertilizer. They shall also have power to open any package or vessel containing or supposed to contain any commercial fertilizer, and to take therefrom samples for analysis upon tendering the value of said samples.

Section 5. Any person selling, offering, or exposing for sale, any commercial fertilizer without the analysis required by section one of this act, or with an analysis stating that it contains a larger percentage of any one or more of the above named constituents than is contained therein, or for the sale of which all the provisions of section two have not been complied with, shall be guilty of misdemeanor, and on conviction shall forfeit a sum not less than twenty-five and not exceeding one hundred dollars for the first offense, and not less than two hundred dollars for each subsequent offense. It shall be the duty of the Secretary of Agriculture to enforce the provisions of this act, and all penalties, costs and fines recovered shall be paid to him or his duly authorized agent, and by him be immediately paid into the State Treasury, to constitute a special fund to be used in accordance with the provisions of section six of this act.

Section 6. The money paid into the Treasury under the provisions of this act shall constitute a special fund, from which the cost of selecting samples, making analyses, and other expenses incident to the carrying into effect the provisions of this act. shall be paid: Provided, That the total amount thus expended shall in no case exceed the amount paid into the Treasury.

Section 7. The term "commercial fertilizers," as used in this act, shall be taken to mean any and every substance imported, manufactured, prepared or sold for fertilizing or manuring purposes, except barnyard manure, marl, lime, and wood ashes, and not exempt by the provisions of section one of this act.

Section 8. This act shall go into effect on and after the thirty-first day of December, one thousand nine hundred and one. All acts or parts of acts inconsistent with this act are hereby repealed, except that existing laws are to continue in force until this act goes into effect.

Approved—The 25th day of March, A. D. 1901.

PREFACE.

Harrisburg, Pa., December 31, 1901.

The following report, containing analyses of samples of Commercial Fertilizers, collected by the agents of the Department of Agriculture from January 1, to December 31, 1901, is herewith presented, for the information of the public.

The usual discussion by the Chemist, of changes in the prices of the ingredients of fertilizers, which have occurred since August 1, 1900, is appended, together with a schedule of prices fixed for the current year.

The foot notes refer to the page where the appropriate list of prices may be found; and farmers are urged to use these data, and compute for themselves, the value of the composition which they expect to purchase.

The attention of manufacturers and dealers in Commercial Fertilizers, is called to the new law, which is printed for information in this bulletin. The law changes the license fee from ten dollars to fifteen dollars for sales of one hundred tons or less, of each and every brand sold within the State the previous year.

The powers of the Secretary of Agriculture, in the matter of enforcing the law, have been enlarged. The date of going into effect, of the new law, is fixed at December 31, 1901.

Manufacturers in sending in their list of brands of fertilizers sometimes use a slightly different wording on their sacks from that furnished this Department. Agents of the Department in reporting are required to copy the precise words used on the sack. If any change has been made in branding, from the designation sent to this office, we regard the brand so changed as UNLICENSED, and a separate license must be taken out.

Manufacturers are, therefore, cautioned to use the exact language in marking the sacks, that they have furnished to the Department for record.

Commercial fertilizers are now a recognized necessity in the agriculture of Pennsylvania, and our farmers will have to post themselves as to the action of the various substances that compose them, or pay the penalty which is always exacted from ignorance. There was a time when the farmer could not know what to purchase, or how to purchase. That time is past, and if he is deceived now, it is his own fault. Full information is at his disposal if he will take and use it.

JOHN HAMILTON,
Secretary of Agriculture.

FERTILIZER VALUATIONS—1901.

The object of an official valuation of commercial fertilizers is to enable the consumer to judge approximately whether he has been asked to pay for a given brand more than the fertilizing ingredients it contains and market conditions prevailing at the time would warrant. It is clear, therefore, that no attempt is made in this valuation to indicate whether the fertilizer valued possesses a greater or less crop-producing capacity than another fertilizer; but only whether it is higher priced than another of the same general composition.

For this purpose it must be so computed as to include all the elements entering into the cost of a fertilizer as it is delivered to the consumer. These elements may be conveniently grouped as follows:

1. The wholesale cost of the ingredients.

2. The jobbers' gross profit on the sale of the ingredients; this includes office expenses, advertising, losses, etc.; for the purpose of the present computation it may be assumed that the sum of this gross profit and the wholesale cost of the ingredients, is equivalent to the retail price of the single ingredients near the wholesale markets in ton lots of original packages for cash.

3. The expense and profit of mixing: This item applies only to complete fertilizers, rock and potash, and ammoniated rock; not to dissolved or ground bone, or to dissolved rock.

4. The expense and profit of bagging.

5. Agents' commission: This item includes not only the commission proper, but every advance in price due to the sale of the goods through an agent in small quantities on time, rather than directly to the consumer in ton lots for cash.

6. Freight from the wholesale market to the point of delivery.

The valuations for 1900 were based:

1. Upon the wholesale prices from September 1, 1899, to March 1, 1900, of the raw materials used in fertilizer manufacture, the quotations of the New York market being adopted for all materials except acidulated phosphate rock and ground bone.

2. Upon an allowance of 20 per cent. of the wholesale prices, above mentioned, to cover jobbers' profits.

By adding the 20 per cent. allowed for jobbers' gross profit to the wholesale price of the several raw materials, the retail price in original packages at the jobbers' warehouse is obtained.

Since the amount of the several valuable fertilizing constituents in the various raw materials is known, it is a simple matter to determine the corresponding retail value per pound of the valuable fertilizing constituents yielded by each raw material. A schedule of these pound values affords a convenient basis of computation of the value per ton of various fertilizers, whose composition is ascertained by analysis.

The values assigned, for the present, to the other elements in the cost of the fertilizer at the point of delivery are:

3. For mixing, $1.00 per ton.

4. For bagging, $1.00 per ton, in all cases except those in which the article was sold in original package; the cost of the package being, in such cases, included in the wholesale price.

5. For agents' commission, 20 per cent. of the cost of the goods f. o. b. at the jobbers' or mixers' warehouse.

6. For freight, $2.00 per ton; the cost of the freight in lots of twelve tons or over, from the seaboard to Harrisburg, averaging $1.88 per ton.

The following valuation of dissolved South Carolina rock illustrates the method:

Phosphoric acid.	Per cent.	Weight per ton.	
Soluble,	11.50	230 lbs. at 3c.	$6 90
Reverted,	2.50	50 lbs. at 2½c.	1 25
Insoluble,	1.00	20 lbs. at 1½c.	30
Retail cash value of ingredients,			$8 45
Bagging,			1 00
Cash value of goods ready for shipment,			$9 45
Agents' commission, 20 per cent.,			1 89
Freight,			2 00
Commercial value per ton,			$13 34

It is not to be expected, of course, that the valuations thus computed will precisely represent the fair price to be charged for a brand in each locality and in every transaction. Market conditions, competition, distance from factory, all introduce minor variations. Nevertheless, to make the approximation reasonably close, the average valuation of a given class of goods ought to agree closely with its ascertained average selling price. Whenever such an agreement is no longer obtained by the use of a schedule, it is evident that the schedule of retail values of the constituents, or the added allowances for mixing, etc., requires revision.

It is needful to note here another factor greatly affecting the practical accuracy of these approximations. Their computation would offer little difficulty and their usefulness be far greater, if, by the ordinary methods of analysis, the exact nature of the ingredients used to supply the several fertilizer constituents, were capable of certain determination. This is, however, possible, to-day, to only a limited extent. The valuations are, therefore, based on the assumption that the fertilizers are uniformly compounded from high quality ingredients, such as are commonly employed in the manufacture of fertilizers of the several classes. Consumers shou'd carefully avoid the error of accepting such valuations as infallible; they are not designed to be used for close comparison of single brands, but only to indicate whether the price asked for a fertilizer is abnormal, assuming good quality for the ingredients used. From this it is clear that, except as high freights may require, the selling price of a brand should not far exceed the valuation; but that a fertilizer may be made of inferior materials and yet have a high valuation.

The valuations used during 1899 were modified for use during 1900 in accordance with the changes in wholesale prices of fertilizing ingredients and to make the valuations more closely follow the selling price.

The following comparative statement shows the valuations and selling prices of the several classes of fertilizers during 1899 and 1900.

Fertilizers.	Number of samples.	Valuation.	Selling price.	Difference of valuation from selling price.
Spring, 1899.				
Complete,	250	$24.53	$23.60	$0.93
Rock-and-potash,	47	15.05	16.83	—1.78
Dissolved bone,	8	21.75	21.75	0.00
Ground bone,	38	28.06	26.67	1.39
Dissolved rock,	58	14.02	13.36	0.66
Fall, 1899.				
Complete,	181	23.38	22.98	0.40
Rock-and-potash,	41	14.53	17.28	2.75
Dissolved bone,	7	22.30	19.00	3.30
Ground bone,	24	27.37	24.98	2.39
Dissolved rock,	55	13.19	12.64	0.55
Spring, 1900.				
Complete,	276	24.61	25.38	—0.77
Rock-and-potash,	48	14.71	17.35	—2.64
Dissolved bone,	2	30.87	26.00	4.87
Ground bone,	30	25.91	28.42	—2.51
Dissolved rock,	56	13.48	13.57	—0.09
Fall, 1900.				
Complete,	130	24.00	23.22	0.81
Rock-and-potash,	33	14.63	18.11	—3.48
Dissolved bone,	3	22.74	23.50	—0.76
Ground bone,	17	26.87	28.73	—1.86
Dissolved rock,	31	12.11	12.96	—0.85

The figures for 1900 exhibit an unusual difference between the control valuations and the actual selling prices in the case of incomplete fertilizers; this is the more notable because of the satisfactory agreement between valuation and selling price in the case of the complete fertilizers. As usual, the rock and potash mixtures exhibit the same relative elevation of selling price to which attention has been called in preceding years. It is very probable that the marked centralization in the organization of the retail trade which the last year or two has witnessed may account for this stiffening of retail prices of the commonly used, incomplete fertilizers.

The general tendencies of the wholesale market may be judged from the following comparative statement, obtained from the weekly reports of the *Oil, Paint and Drug Reporter*, of New York city, showing the average wholesale prices of fertilizer raw materials from September 1, 1899, to March 1, 1900, and from September 1, 1900, to March 1, 1901:

Wholesale Prices of Fertilizer Ingredients, New York: *Oil, Paint and Drug Reporter.*

Substance.	Amount Priced.	Average price, Sept., 1899, to March, 1900.	Average price, Sept., 1900, to March, 1901.	Prices Sept.–Febr'y, 1900-01, in per cent. of prices 1899-1900.
1. Sulfate of ammonia,	Cwt.,	$2.9730	$2.8005	94.2
2. Nitrate of soda,	Cwt.,	1.7870	1.8153	101.6
3. Dried blood, H. G.,	Unit (20 lbs.),	2.0733	2.3127	111.5
4. Dried blood, L. G.,	Unit (20 lbs.),	1.8275	2.236	122.3
5. Concentrated tankage,	Unit (20 lbs.),	1.782	1.6227	91.1
6. Rough bone,	Ton,	20.875	20.983	100.5
7. Ground bone,	Ton,	22.15	21.842	98.6
8. Bone meal,	Ton,	24.441	19.70	80.6
9. Fish guano (dry),	Ton,	20.316	23.00	113.2
10. Fish guano (acid),	Ton,	11.136	12.00	107.7
11. Refuse bone-black,	Ton,	19.875	19.30	97.1
12. Phosphate rock (Charleston),	Ton,	*2.75	†7.25	....
13. Phosphate rock (Tennessee),	Ton,	....	3.25	....
14. Phosphate rock (land, 70 per cent.),	Ton,	3.125	....	....
15. Acid phosphate,	Unit (20 lbs.),	.620	.6422	103.6
16. Double manure salts,	Cwt.,	1.0387	1.0725	103.2
17. Sulfate of potash,	Cwt.,	2.0079	2.07	103.2
18. Kainit,	Ton,	9.3937	9.30	99.0
19. Muriate of potash,	Cwt.,	1.8106	1.8475	102.0
20. Sulfuric acid, 66 degrees B.,	Cwt.,	1.475	1.475	100.0

*Crude at mines.
†Kiln-dried f. o. b. New York.

In ammoniates, such as dried blood or concentrated tankage, the unit is of ammonia, of which 82.35 per cent. is nitrogen; in acid phosphates, the unit is of phosphoric acid (phosphorus pentoxid).

Giving attention first to the nitrogenous materials and animal sources of phosphoric acid: These figures show a decrease in the prices of ammonium sulfate and concentrated tankage during the season of 1900-1, as compared with that of 1899-1900; those of dried blood and fish guano have, on the other hand, distinctly advanced; those of nitrate of soda, rough bone and refuse bone-black remaining practically stationary, though quotations for bone meal are much reduced.

The following data are taken from the monthly reports of Thomas J. White & Co., fertilizer brokers of Baltimore, Md., giving wholesale quotations upon "ammoniates":

Wholesale Prices of Ammoniates: Reports of Thomas J. White & Co., Baltimore, Maryland:

	Prices, Sept. to March, 1899-1900.	Prices, Sept. to March, 1900-1901.
Sulfate of ammonia, per cwt.:		
Foreign, f. o. b., Baltimore,	*$2 97	$2 76
Domestic, f. o. b., Boston,	*2 96	2 76
Ground blood, f. o. b., Chicago, per unit of ammonia,	1 54	2.12
Concentrated tankage, f. o. b., Chicago, per unit of ammonia,	1 51	1 96
Crushed tankage, f. o. b., Chicago, per ton:		
6½ per cent. ammonia, 25 per cent. bone phosphate,	....	‖13 91
7 per cent. ammonia, 25 per cent. bone phosphate,	13 00	....
8 per cent. ammonia, 20 per cent. bone phosphate,	....	....
9 per cent. ammonia, 20 per cent. bone phosphate,	14 79	....
9½ per cent. ammonia, 18 per cent. bone phosphate,	†16 44	....
9½ per cent. ammonia, 15 per cent. bone phosphate,	....	....
10½ per cent. ammonia, 15 per cent. bone phosphate,	‡17 20	**22 63
10 per cent. ammonia, 10 per cent. bone phosphate,	....	**20 375
Crushed tankage, c. a. f., Baltimore, per unit ammonia,	§1 90	2 29
Dried fish, f. o. b., factory, per unit ammonia,	....	††2 14

*c. i. f., Baltimore, quotations for December and January lacking.
†Quotations lacking for September and October.
‡Quotations lacking for September.
§Quotations for September and January lacking.
All quotations for January are lacking.
‖Lacking February quotations.
**Lacking December quotations.
††Lacking December and February quotations.

Direct comparison is unfortunately possible in only a few of the items of the foregoing table. In general, they indicate a decrease of 7 per cent. in the prices of gas-liquor sulfate of ammonia, and in the other ammoniates increases as follows:

Ground blood, 38 per cent.; concentrated tankage and crushed tankage, 10½ and 15, 30 per cent., and crushed tankage, per unit of ammonia, 20 per cent.

The same authorities quote nitrate of soda at an average of $1.80 per cwt., from September through December, 1900.

From the market reports of the *Engineering and Mining Journal* of New York City, the following comparative statement has been compiled:

Wholesale Prices of Ammonia, 1900-1: *Engineering and Mining Journal.*

	January, 1900.	January, 1901.
Sulfate of ammonia, gas liquor (15 per cent ammonia), domestic per cwt.,	[illegible]	[illegible]
Nitrate of soda, per cwt.,	1.80-1.87½	[illegible]
Dried blood, per unit of ammonia:		
Western, high grade, f. o. b., Chicago,	[illegible]	[illegible]
New York, soft,	[illegible]	[illegible]
Tankage, high grade Western, f. o. b., Chicago, per unit of ammonia,	[illegible]	[illegible]
†Bone, Calcutta, No. 2, per ton,	[illegible]	[illegible]
†Bone, Calcutta, No. 3, per ton,	24.?0	[illegible]
†Bone, domestic, steamed, ground,	[illegible]	[illegible]

*For one week only, when there was a temporary rise in price.

†Owing to lack of data for January, 1900, the comparisons are made for February of the two years.

These figures, while not precisely concordant with those of the *Oil, Paint and Drug Reporter*, exhibit the same general market tendencies.

Taking all these data together, they establish the fact of a slight decrease in the wholesale prices of sulfate of ammonia, a slight increase in that of nitrate of soda and a very marked increase in the prices of dried blood, fish and tankage, while bone has remained stationary, or, in certain grades, markedly decreased in price.

As for the values of the ingredients supplying phosphoric acid: The tendencies of bone and tankage have already been discussed. Refuse bone-black has changed little, the general movement having been toward a slight decrease in price.

Relative to the production and prices of raw rock phosphates: The statistics of the *Engineering and Mining Journal* show a total production of 1,599,990 long tons from the phosphate mining operations of the United States in 1900, as compared with 1,823,391 mined in 1899; the average values of the products of the two years were $3.86 per ton in 1899 and $3.48 in 1900. The detailed statistics of production and shipment for the past year in the several principal regions of production are as follows:

Production and Shipment of Phosphate Rock, 1900.

Region.	Production.		Shipments.					
			Domestic		Foreign.		Total.	
	1899.	1900.	1899.	1900.	1899.	1900.	1899.	1900.
Florida, ...	706,677	582,900	88,321	101,000	583,132	430,790	671,453	531,790
Tennessee, ...	462,561	436,000	277,447	275,000	163,114	140,000	440,561	415,000
S. Carolina, ...	636,153	562,000	432,187	389,500	94,921	63,500	527,108	453,000
N. Carolina, ...	15,000	15,250	15,000	15,250	....	....	15,000	15,250
Pennsylvania, ...	3,000	3,750	3,000	3,750	....	....	3,000	3,750
	1,822,391	1,599,990	815,955	784,500	841,167	634,290	1,657,122	1,418,790

Thus, there was a falling off of about 12 per cent. in production and of 14 per cent. in shipments. The decrease in shipments was confined almost wholly to the foreign trade, which fell off 24.6 per cent., while domestic shipments decreased only 3.8 per cent. The falling off of the foreign shipements did not occur until the season was somewhat advanced; earlier shipments were brisk; the later decrease was due to a slackening demand with continued high rates of ocean freight.

Florida phosphate: High grade rock exports fell off 22.8 per cent., as compared with those of 1899; pebble phosphate exports, 37 per cent. On the other hand, the cost of production increased in all important items. The price of high grade rock (77 to 80 per cent. bone phosphate), f. o. b. Fernandina, January, 1900, was $9.50 to $10.00, weakening in the following months to $7.50 to $8.50 and closing in October at $7.50 to $8.00. The outside prices in 1899 were $8.50 to $11.00, showing a decrease of at least $1 per ton during 1900. Land pebbles (68 to 73 per cent. bone phosphate), held at $4.35 per long ton f. o. b. Fernandina.

The export trade in Peace River rock or pebble phosphate fell off heavily, but domestic trade was regular, prices f. o. b. Fernandina for 58 to 63 per cent. bone phosphate grade, were: In January, 1900, $4.50; March, $3 to $4; April, $3 to $3.50, which prices held to the end of the year, as the product was under contract. During 1899, the rock sold as high as $4.50 per ton. During January of the present year, prices fell for hard rock from $7.50-$8.00 to $6.50-$7.00; for land pebble from $4.35 to $3.85-$4.00; for Peace River pebble from $3.00-$3.50 to $2.50-$2.75, and held at those prices up to March 1st.

Tennessee phosphates: Demand was good, but less active than in 1899, prices were more satisfactory because of an understanding between operators. Export rock sold during the year at $2.85 to

$4.75 per long ton f. o. b. Mt. Pleasant; in 1899, from $2.15 to $3.90. Domestic grades sold, 78 per cent. phosphates at $2.75 to $3.75; 75 per cent, at $2.50 to $3.25; 65 to 72 per cent. at $2.25 to $2.75; during 1899, the high-grade domestic reached to $2.50 to $2.75; low grade, $2.25 to $2.50; during the first two months of this year, prices rose a few cents.

South Carolina phosphates were held at a quite uniform price during 1900, the product being controlled by a few large companies. The price for crude rock dropped from $4.25 to $4.50 per ton f. o. b. Fettersea in January to $3 in June, from which it rose to $4 in October; for kiln-dried rock, the prices on the same basis were $4.75 to $5.00 in January and remained at $5 until October, when they dropped to $4.50; during January and February of this year, prices held at $3.75 to $4.00 for crude rock at the mines and $4.50 for kiln-dried f. o. b. Ashley river.

These figures show little change in the prices of South Carolina rock, a distinct decrease in the prices of the lower grade Florida river pebble and in Tennessee phosphates an advance of 25 cents to $1, i. e., from 10 to 30 per cent., according to grade; also, while the South Carolina products dominated the domestic trade, as heretofore, those of Tennessee formed a very influential factor in determining prices. The quotations of the *Oil, Paint and Drug Reporter* for crude and kiln-dried rock cover a brief period and are not comparable with the figures given for the corresponding season of 1899-1900.

Considering the cost of the acid used in acidulation of the soluble phosphates, and the raw materials of acid manufacture: While brimstone continues to be replaced more and more by pyrites as a raw material for sulfuric acid manufacture, the actual consumption was somewhat increased in 1900 as compared with 1899. The report of the U. S. Bureau of Statistics show the imports for the year ending June 30, 1899, to have been 129,392.44 long tons, at $18.41 per ton; June 30, 1900, 155,089.30 long tons, at $17.42 per ton; i. e., at a decrease of 5.4 per cent. in price.

The *Engineering and Mining Journal* gives the total imports for the calendar years as follows: 1899, 143,234 tons; 1900, 153,000 tons. Prices were maintained by the Anglo-Sicilian Sulphur Company, but freight rates increased from lack of ballast room. The prices of best unmixed "seconds" spot, New York, were, Jan., 1899, $21.25 to $22.00; November, $22.00; 1900, January, $21.78; November, $22.25, average for the calendar year, $22.18. Best unmixed "thirds," $2 less. Sellings slow, late in the year, pending the fixing of the scale for 1900-1901.

The relative increase in the production of pyrites for acid manufacture continued; the exhaustion of the Pilley's Island deposits was offset by discoveries of valuable beds in Virginia, Alabama and

Tennessee. The reports of the U. S. Bureau of Statistics show imports during the year ending June 30, 1899, of 336,034 tons at $3.17; during that ending June 30, 1900, of 334,131 tons at $3.61, most of the imports being from Spain; deliveries being made under contract, for the most part, prices varied little during the year. According to the *Engineering and Mining Journal* quotations were as follows:

> Virginia pyrites, f. o. b., Mineral City, $4.50 to $4.75 per long ton for 'lump,' $4.20 for 'fines' (basis, 42 per cent. of sulfur); Massachusetts pyrites, f. o. b. Charlemont, $5.50 for 'lump,' $5 for 'fines' (42 to 45 per cent. basis); Huelva, Spain, pyrites were quoted at 12 to 15 cents per unit of sulfur, ($4.50 to $7.20 per ton) f. o. b. at Atlantic ports.

The prices of the raw materials for acid manufacture, including brimstone, pyrites and nitrate of soda, exhibit therefore no very marked advance.

Concerning the acid itself, the authority last quoted states that consumption was increased and that the New York prices were well maintained under the regulation of the General Chemical Company. Acids were delivered largely under contracts made late in 1899 and early in 1900. Prices at New York in drums, per cwt., were for 66° acid, $1.20; for 60°, $1.05; for 50°, f. o. b. factory, $14 to $16 per long ton. So that, as compared with the season, 1899-1900, there has been no marked advance in price of the acid.

While these figures exhibiting the fluctuations of the values of the raw materials used in the manufacture of super-phosphates, are of interest as affecting the retail price of the manufactured goods, the wholesale prices of the latter are of more immediate importance. The wholesale quotations of the *Oil, Paint and Drug Reporter* for acid phosphates, high grade, New York, during 1899-1900, average 62 cents per unit of available phosphoric acid; during 1900-1, 64.2 cents—a trifling advance. The *Engineering and Mining Journal* quotes high grade acid phosphate (Tennessee) f. o. b. Nashville, at $10-$12 per ton; low grade, $8-$10; high grade South Carolina acid phosphate, f. o. b. Charleston, at $6-$6.50 per ton—the market being demoralized during the last quarter by over-stocking; prices in New York are quoted as 60 to 65c per unit, thus confirming those above quoted.

This review of the wholesale market exhibits, therefore, no natural cause for any considerable advance in the prices of dissolved rock.

Potash salts: The reports of the U. S. Bureau of Statistics show the following entries for consumption during the fiscal years 1899 and 1900:

	1899.	1900.
Muriate (pounds),	95,777,170	113,032,418
Kieserit, kainit, etc. (tons),	127,233	133,244

The prices of German potash salts are regulated by the German Potash Syndicate. On the basis of large lots sold through brokers for cash and delivered at Boston, New York or Philadelphia, the schedules announced by the Syndicate are as follows:

Salt.	After March 1, 1900.	February, 1901.	After March 1, 1901.
Muriate:			
(80 to 85 per cent., 80 per cent. basis), cwt.,	$1 80	$1 80	$1 83
(95 per cent., 80 per cent. basis), cwt.,	....	1 83	1 86
Sulfate:			
(90 per cent., 90 per cent. basis), cwt.,	20 25	2 08	2 11
(96 per cent., 90 per cent. basis), cwt.,	....	2 11	2 14
Double manure salt (48 to 50 per cent., 48 per cent. basis), cwt.,	1 04	1 09	1 12
Kainit (12.4 per cent. actual potash) per ton at port of shipment,	8 80	8 80	....
Sylvinite (per unit potassium sulfate),	....	38-39	....
Manure salt (20 per cent. potash), per unit potash,	....	62-64	....

This trade is so managed that, before March 1, nearly all wholesale deliveries of the year are contracted for. The prices fixed are about 3 per cent. in advance of those for 1900.

Composition of Raw Materials.

In order to form a correct idea of the cost per pound of the fertilizing constituents of these materials, it is needful to determine their composition; or, in other words, the quantities of valuable materials each contains. With the exception of ground bone and dissolved rock phosphates, very few of the single ingredients of fertilizers have been analyzed in Pennsylvania during the past year; in the following table, the averages include the results of analyses made in Massachusetts, Connecticut, New Jersey and Pennsylvania, except in the case of ground bone and dissolved rock phosphates, where Pennsylvania results alone have been included.

Composition of Non-acidulated Fertilizer Ingredients (Per Cent.).

	Number of samples analyzed.	Nitrogen.	Potash.	Total phosphoric acid.
Sulfate of ammonia,	4	20.53	....	....
Nitrate of soda,	10	15.62	....	....
Dried blood,	4	11.98	....	....
Ground bone,	47	3.07	....	21.99
Tankage,	9	5.14	....	17.13
Ground fish,	19	7.26	....	6.85
Cotton seed meal,	45	7.27	1.90	3.15
Castor pomace,	6	5.31	1.05	1.94
Sulfate of potash, high grade,	6	....	48.36	....
Muriate of potash,	16	....	50.68	....
Kainit,	6	....	13.21	....
Double sulfate of potash and magnesia,	5	....	27.01	....

Composition of Acidulated Fertilizer Ingredients (Per Cent.).

	Number of samples analyzed.	Total phosphoric acid.	Soluble phosphoric acid.	Reverted phosphoric acid.	Insoluble phosphoric acid.
Dissolved bone black,	6	17.62	14.67	2.39	.56
*Dissolved bone,	4	14.77	2.08	4.67	8.02
Dissolved rock phosphate,	87	15.80	8.89	5.00	1.91

*Also contains 3.19 per cent. of nitrogen.

Considering only those materials sold by the ton or hundredweight, rather than by the unit, the bone and fish show less of the valuable constituents, the tankage more of phosphoric acid and less of nitrogen than usual, while the kainit exhibits a little higher average than in years preceding. This survey exhibits no considerable modification in the character of the raw materials used for fertilizer manufacture.

Cost per Pound of Fertilizer Constituents.

From the foregoing data showing the cost per ton, hundredweight, or other unit of measure, of the several raw materials, and the quantities of valuable constituents the average materials now on the market contain, the wholesale cost per pound of the valuable con-

stituents can be readily estimated. In the case of ammoniates, the quotations are "per unit of ammonia" in many cases. The term "unit" is equivalent to "per cent.;" in goods sold by the ton of 2,000 lbs., the unit is equal to 20 lbs.; and 20 lbs of ammonia contains 16.47 lbs. of nitrogen.

In the case of refuse bone-black, unacidulated, the mean, 28.25 per cent. of phosphoric acid, is assumed to represent the average material on the market.

Phosphate rock is sold by the ton of 2,240 lbs.; this material is sold on the basis of the bone phosphate of lime it contains, with drawbacks for injurious constituents. Since the bone phosphate of lime contains 45.8 per cent. of phosphoric acid, each per cent. of bone phosphate in a long ton of phosphate rock is equivalent to 22.4 lbs. and contains 10.26 lbs. of phosphoric acid.

In the wholesale trade, it is customary to sell dried blood, azotine, horn and hoof meals, and concentrated tankage solely on the basis of ammonia, to the entire disregard of the phosphoric acid contained. Likewise, the insoluble phosphoric acid in dissolved rock is omitted from consideration, and contracts are based solely upon the "available" phosphoric acid; that is, the sum of the "soluble" and "reverted" or "citrate soluble" phosphoric acid; nor in rock phosphates is any claim made for the small quantities of nitrogen and potash they always contain, nor in dissolved bone for the potash present.

Under these conditions, the wholesale cost per pound in New York of the valuable constituents of such materials as furnish but a single fertilizing element, these materials being assumed to be in the state of preparation and in the package in which the manufacturer purchased them, are given in the following table; also, a figure representing a fair retail price at the factory, the materials having undergone no change in treatment or packing, and the allowance for expense and profit in retailing being 20 per cent.

Wholesale Cost per Pound of Fertilizer Constituents (New York.)

I. Ingredients Supplying One Constituent.

Material.	Constituent valued.	Wholesale price. Cents.	Wholesale price plus 20 per cent. Cents.
Sulfate of ammonia,	Nitrogen,	13.64	16.37
Nitrate of soda,	Nitrogen,	11.62	13.94
Dried blood, high grade,	Nitrogen,	14.04	16.85
Dried blood, low grade,	Nitrogen,	13.58	16.30
Concentrated tankage,	Nitrogen,	9.85	11.82
Refuse bone-black,	Phosphoric acid, total,	3.42	4.10
*Phosphate rock:			
(Peace river, 60 per cent.),	Phosphoric acid, total,	.53	.64
(Tennessee, 78 per cent.),	Phosphoric acid, total,	.41	.49
(South Carolina, 60 per cent.),	Phosphoric acid, total,	.73	.88
Acid phosphate,	Phosphoric acid, available,	3.21	3.85
Double manure salts,	Potash,	4.20	5.04
Sulfate of potash,	Potash,	4.28	5.14
Muriate of potash,	Potash,	3.56	4.27
Kainit,	Potash,	3.55	4.26

*The prices of phosphate rock are f. o. b. at the respective points of shipment, not New York. The data for rock prices are taken from the reports of the *Engineering and Mining Journal*; the prices for potash from the schedule of the Syndicate; the rest from the *Oil, Paint and Drug Reporter.*

The quotations for bone are given without specific reference to quality, so that it is impossible from these data to fairly apportion their several wholesale values to the nitrogen and the phosphoric acid contained in this material. As compared with tankage, the general tendency is to assign a higher commercial rating to the phosphoric acid in bone and to the nitrogen a rating not very different from that given in tankage.

The quotations of Thos. J. White & Co., show an average wholesale rate in Baltimore during September, 1900, to March, 1901, for crushed tankage to have been $2.29 per unit of ammonia and $0.10 per unit of bone phosphate of lime; this is equivalent to $2.78 per unit of nitrogen (13.94c per pound), and $0.218 per unit of phosphoric acid (1.1c per pound).

The average composition of the ground bone and bone meal samples analyzed in Pennsylvania, last Fall, was:

Phosphoric acid, 22.52 per ecnt.; nitrogen, 3.18 per cent.

The prepared bone contains less fat and moisture, and often less nitrogen than the ordinary "rough bone"; but these differences tend, in a manner, to neutralize each other.

Assuming for the rough bone quoted in the New York markets the same composition as the bone meal sold in Pennsylvania, and for the value of the nitrogen, $2.78 per unit, the values per pound of the several constituents would be:

Wholesale Cost per Pound of Fertilizer Constituents, New York.

II. Bone.

Grade.	Constituent valued.	Wholesale price.	Wholesale price plus 20 per cent.
Rough bone,	Nitrogen,	13.9	16.7
	Phosphoric acid,	2.69	3.13
Ground bone,	Nitrogen,	14.47	17.38
	Phosphoric acid,	2.80	3.26

These figures tend to be too high, for the reason that the average ground bone and bone meal on the retail market are probably inferior in composition to the rough bone on the wholesale market. There are no wholesale data available for the direct estimation of the wholesale pound values of acidulated bone (animal bone); the schedule must, upon this point, depend upon retail selling prices.

VALUATIONS IN NEIGHBORING STATES.

It is desirable, from all points of view, that the schedules of valuation throughout a district in which similar market conditions prevail, should differ as little as possible. It has been our practice in the past, to conform our schedule to that adopted after very careful co-operative study of market conditions for each year, by the New England states and New Jersey, except where the peculiar conditions of our market have made the valuations diverge too largely from the actual selling prices, as in the case of ground bone and dissolved rock phosphates.

The schedules for these States for 1900 and 1901 are as follows:

Trade Values Adopted by the New England Stations and New Jersey.

Ingredients.	Cents per lb. 1900.	Cents per lb. 1901.	Values of 1901 in per cent. of those of 1900.
Nitrogen:			
In ammonia salts,	17	16½	97.1
In nitrates,	13½	14	111.1
In dry and fine-ground fish,	15½	16	103.2
In meat, blood and mixed fertilizers,	15½	16	103.2
In fine-ground bone and tankage,	15½	16	103.2
In coarse bone and tankage,	10½	12	114.3
Phosphoric acid:			
Water soluble,	4½	5	111.1
Citrate soluble,	4	4½	112.5
In cotton-seed meal, castor-pomace and wood ashes,	4	4	100
In dry, fine-ground fish, bone and tankage,	4	4	100
In coarse fish, bone and tankage,	3	3	100
In mixed fertilizers, insoluble,	2	2	100
Potash:			
In forms free from muriate (chlorid),	5	5	100
As muriate,	4¼	4¼	100

The above prices of nitrogenous salts, ammoniates of animal origin and of the potash salts accord quite closely with the New York quotations of the *Oil, Paint and Drug Reporter* for the period, September, 1900, to March, 1901. As to the ground bone, assuming a fineness of 70 per cent. fine and 30 per cent. coarse, the average New England valuations for bone constituents are: Nitrogen, 14.8 cents; phosphoric, acid, 3.7 cents; i. e., the nitrogen value is considerably lower, that of phosphoric acid considerably higher than those derived from the composition of Pennsylvania ground bone and the tankage prices in the Baltimore market.

Upon a careful consideration of the changes and tendencies of the wholesale prices of fertilizer ingredients and of the discrepancies occurring since the adoption of the 1900 schedule of valuation, it has been decided that the schedule for use during 1901 should be the same as that adopted for the use of New Jersey and New England except at two points.

For reasons fully discussed in 1897, it is needful to include in the Pennsylvania schedule of valuations, a distinct set of values for phosphoric acid derived from rock as contrasted with that derived from animal materials. Reference to the tables, given on an earlier page, showing the wholesale cost of a pound of phosphoric acid, will make it plain that when it comes from phosphate rock, it costs the fertilizer maker about one-half to three-fourths of a cent at the mines, on the Atlantic seaboard; when from refuse bone-black, delivered at New York, 3.4 cents; when from tankage, about 1.1 cents; and from bone 2.69 cents.

There is nothing to indicate that, after acidulation, the available phosphoric acid from bone is at all better for the crop than that from a good rock lime-phosphate. But so long as the consumer is persuaded that bone phosphoric acid is worth more for his crop than an equal weight of rock phosphoric acid, just so long will the manufacturer of fertilizers be able to command a higher price for those reputed to derive their phosphoric acid from bone, and just so long will he, in turn, be obliged to pay more for it on the wholesale market. Now, in some States, the volume of rock phosphoric acid used is relatively small and the need for its separate valuation not apparent; in other States it predominates to the almost entire exclusion of bone phosphoric acid, so that no distinct valuation for the latter is required; but in Pennsylvania both occupy important positions upon the market and each requires its own set of values. Despite the slightly upward tendency of the acid phosphate market, it is thought needless to change the valuations of these constituents at this time, because the average valuations have, under the existing schedule, considerably exceeded the actual selling prices.

For similar reasons, nitrogen and phosphoric acid in ground bone are valued at lower rates in Pennsylvania than in New England. Owing to the fact that the bone valuations of the past year fell distinctly below the selling prices, a slight increase in the valuations of these goods has been made. Tankage is scheduled with bone, though costing less, because it is little sold at retail.

The schedule for 1901 as a whole is as follows:

Schedule of Values for Fertilizer Ingredients, 1901.

	Cents per pound.
Nitrogen:	
In ammonia salts,	16½
In nitrates,	14
In meat, dried blood and mixed fertilizers,	16
In cotton-seed meal and castor-pomace,	16
In fine ground bone and tankage,	11
In coarse bone and tankage,	9
Phosphoric acid:	
Soluble in water, in bone fertilizers,	5
Soluble in water, in rock fertilizers,	3
Soluble in ammonium citrate, in bone fertilizers,	4½
Soluble in ammonium citrate in rock fertilizers,	2½
Insoluble in ammonium citrate, in bone fertilizers,	2
Insoluble in ammonium citrate, in rock,	1½
In fine bone, tankage and fish,	3½
In coarse bone and tankage,	2½
In cotton-seed meal, castor-pomace and wood ashes,	4
Potash:	
In high-grade sulfate or in forms free from muriate,	5
As muriate,	4¼

Potash in excess of that equivalent to the chlorin present, will be valued as sulfate, and the remainder as muriate.

Nitrogen in mixed fertilizers will be valued as derived from the best sources of organic nitrogen, unless clear evidence to the contrary is obtained.

Phosphoric acid in mixed fertilizers is valued at bone phosphoric acid prices, unless clearly found to be derived from rock phosphate.

Bone is sifted into two grades of fineness: Fine, less than $\frac{1}{50}$ inch in diameter; coarse, over $\frac{1}{50}$ inch in diameter.

The result obtained by the use of this schedule does not cover the items of mixing, bagging, freight and agents' commission. To cover these, allowances are made as follows:

For freight, an allowance of $2.00 per ton on all fertilizers.

For bagging, an allowance of $1.00 per ton on all fertilizers, except when sold in original packages.

For mixing, an allowance of $1.00 per ton on complete fertilizers and rock-and-potash goods.

For agents' commission, an allowance of 20 per cent. is added to the cash values of the goods ready for shipment.

The mean quotations on freight from New York, Philadelphia and Baltimore to Harrisburg, in January, 1897, was $1.68 per ton, in lots of twelve tons or over; in May, 1899, quotations by the Pennsylvania Railroad were: From New York, $2.40; from Philadelphia, $1.70; and from Baltimore, $1.55; mean rate from the three points, $1.88.

FERTILIZER ANALYSES, JANUARY 1, TO AUGUST 1, 1901.

During the six months ending July 1, 1901, there were received from the authorized sampling agents, eight hundred and seventeen (817) fertilizer samples, of which four hundred and fifty (450) were subjected to analysis, the remainder being rejected either because they represented brands analyzed last season, or because they were regarded as not certainly representative of the brand whose name they bore. When two or more samples representing the same brand were received, equal portions from the several samples were united and the composite sample was subjected to analysis.

The samples analyzed group themselves as follows: 291 complete fertilizers, furnishing phosphoric acid, potash and nitrogen; 1 dissolved bone, furnishing phosphoric acid and nitrogen; 60 rock-and-potash fertilizers, furnishing phosphoric acid and potash; 49 acidulated rock phosphates, furnishing phosphoric acid only; 44 ground bones, furnishing phosphoric acid and nitrogen; 5 miscellaneous fertilizers, which group includes potash salts, nitrate of soda and other substances not readily classified under the foregoing heads.

The determinations to which a complete fertilizer is subjected are as follows: (1) Moisture, useful for the comparison of analyses, for indication of dry condition and fitness for drilling, and also of the conditions under which the fertilizer was kept in the warehouse. (2) Phosphoric acid—total, that portion soluble in water, and, of the residue, that portion not soluble in warm ammonium citrate solution (a solution supposed to represent the action of plant roots upon the fertilizer), which is assumed to have little immediate food value. By difference, it is easy to compute the so called "reverted" acid, which is the portion insoluble in water but soluble in the citrate. The sum of the soluble and reverted is commonly called the "available" phosphoric acid. (3) Potash soluble in water,—most of that present in green sand marl and crushed minerals, and even some of that present in vegetable materials such as cotton-seed meal, not being included because insoluble in water even after long boiling. (4) Nitrogen—this element is determined by a method which simply accounts for all present, without distinguishing between the quantities present in the several forms of ammonium salts, nitrates or organic matter. (5) Chlorin; this determination is made to afford a basis for estimating the proportion of the potash that is present as chlorid or muriate, the cheaper source. The computation is made on the assumption that the chlorin present, unless in excess, has been introduced in the form of muriate of potash; but doubtless there are occasional exceptions to this rule. One part of chlorin combines with

1.326 parts of potash to form the pure muriate; knowing the chlorin, it is, therefore, easy to compute the potash equivalent thereto. (7) In the case of ground bone, the state of sub-division is determined by sifting through accurately made sieves; the cost of preparation and especially the promptness of action of bone in the soil depends very largely on the fineness of its particles, the finer being much more quickly useful to the plant.

The law having required the manufacturer to guarantee the amount of certain valuable ingredients present in any brand he may put upon the market, chemical analysis is employed to verify the guaranties stamped upon the fertilizer sacks. It has, therefore, been deemed desirable in this report to enter the guaranty filed by the manufacturer in the office of the Secretary of Agriculture, in such connection with the analytical results that the two may be compared. An unfortunate practice has grown up among manufacturers of so wording the guaranty that it seems to declare the presence in the goods of an amount of a valuable constituent ranging from a certain minimum to a much higher maximum; thus, "Potash, 2 to 4 per cent." is a guaranty not infrequently given. In reality, the sole guaranty is for 2 per cent. The guaranteed amounts given for each brand in the following tables, are copied from the guaranties filed by the maker of the goods with the Secretary of Agriculture, the lowest figure given for any constituent being considered to be the amount guaranteed. For compactness and because no essentially important fact is suppressed thereby, the guaranties for soluble and reverted phosphoric acid have not been given separately, but are combined into a single guaranty for available phosphoric acid; in cases where the maker's guaranty does not specifically mention available phosphoric acid, the sum of the lowest figures given by him for soluble and reverted phosphoric acid is used. The law of 1879 allows the maker to express his guaranty for nitrogen either in terms of that element or in terms of the ammonia equivalent thereto; since ammonia is composed of three parts of hydrogen and fourteen parts of nitrogen, it is a very simple matter to calculate the amount of one, when the amount of the other is given; the amount of nitrogen multiplied by 1.214 will give the corresponding amount of ammonia, and the amount of ammonia multiplied by 0.824 will give the corresponding amount of nitrogen. In these tables, the expression is in terms of nitrogen. Many manufacturers after complying with the terms of the law, insert additional items in their guaranties, often with the result of misleading or confusing the buyer; the latter will do well to give heed to those items only that are given as the law requires and that are presented in these tables.

A summary of the analyses made this season may be presented as follows, excepting the miscellaneous class:

Summary of Analyses Made this Season.

	Complete fertilizers.	Dissolved bone.	Rock and potash.	Dissolved rock.	Ground bone.
Number of analyses,	291	1	60	49	44
Moisture, per cent.,	9.79	9.11	11.62	11.00	6.42
Phosphoric acid:					
Total, per cent.,	10.69	18.37	12.07	14.69	22.94
Soluble, per cent.,	5.21	1.60	5.92	9.91	....
Reverted, per cent.,	3.25	12.95	4.77	4.47	....
Insoluble, per cent.,	2.23	3.82	1.38	1.31	....
Potash, per cent.,	3.64	....	2.52	....	....
Nitrogen, per cent.,	1.55	2.12	....	....	3.28
Mechanical analysis of bone:					
Fine,	....	....	....	....	66
Coarse,	....	....	....	....	34
Commercial valuation,	24.84	29.00	14.60	13.52	28.71
Average selling price,	23.92	28.00	16.29	13.50	27.59
Commercial value of samples whose selling price is ascertained,	24.76	29.00	14.60	13.51	28.71

The cases of departure of goods from their guaranteed composition observed this season, including only those cases in which it amounted to two-tenths per cent. or more, were as follows:

Summary of Instances of Deficiency from Guaranty.

	Complete fertilizers.	Dissolved bone.	Rock and potash.	Dissolved rock.	Ground bone.
Deficient in four constituents,	....	....	....	....	....
Deficient in three constituents,	6	....	1	....	....
Deficient in two constituents,	26	....	1	4	1
Deficient in one constituent,	60	....	17	7	14
Total samples in which deficiency occurred,	92	....	19	11	15

The cases of deficiency noted during the past five seasons in the goods as compared with their guaranties, expressed in percentage of the total number of goods of each class analyzed, are as follows:

Percentages of Deficiency, 1899-1901.

	Spring, 1899.	Fall, 1899.	Spring, 1900.	Fall, 1900.	Spring, 1901.
Complete fertilizers,	38.4	33.7	42.0	40.8	31.6
Dissolved bone,	50.0	14.3	*50.0	*50.0	†
Rock-and-potash,	19.1	34.2	29.2	33.3	31.7
Dissolved rock,	13.8	14.5	5.4	19.4	22.5
Ground bone,	18.4	25.3	36.7	11.8	34.1
All classes except miscellaneous,	30.9	29.2	35.2	34.3	30.8

*Only two samples analyzed.
†Only one sample analyzed.

These figures show changes from year to year; in 1900 there was an exceptional increase, both Spring and Fall, in such deficiencies; but, this Spring, the number has dropped back to normal. In most samples which are found below guaranty at one point, there is an excess at some other point, indicating that the cause of departure from the composition guaranteed lay not in the failure of the manufacturer to use the requisite components, but in his failure to secure a uniform mixture.

It is of interest to note how closely the system of valuations, based upon the wholesale prices of raw materials in the principal markets during the most important buying season and upon certain average allowances for expense and profit on the part of the mixer and jobber, coincides with the retail prices later ascertained. A comparison for several seasons past is given below.

Comparison of Selling Price and Valuation, 1899-1901.

	Selling price.	Valuation.	Excess of valuation over selling price.
Complete fertilizers:			
1899, Spring,	$23.60	$24.70	+$1.10
Fall,	22.98	23.42	+.44
1900, Spring,	25.38	24.61	—.77
Fall,	23.22	23.84	+.62
1901, Spring,	23.92	24.76	+.84
Dissolved bone:			
1899, Spring,	21.75	21.81	+.06
Fall,	19.00	21.12	+2.12
1900, Spring,	26.00	30.87	+4.87
Fall,	23.50	22.74	—.76
1901, Spring,	28.00	29.00	+1.00
Rock-and-potash:			
1899, Spring,	16.83	15.16	—1.67
Fall,	17.28	14.53	—2.75
1900, Spring,	17.35	14.71	—2.64
Fall,	18.11	14.63	—3.48
1901, Spring,	16.20	14.60	—1.60
Dissolved rock:			
1899, Spring,	13.36	14.03	+.67
Fall,	12.64	13.13	+.49
1900, Spring,	13.57	13.48	—.09
Fall,	13.96	13.11	—.85
1901, Spring,	13.90	13.51	—.39
Ground bone:			
1899, Spring,	26.67	28.11	+1.44
Fall,	24.98	27.23	+2.25
1900, Spring,	28.42	25.91	—2.51
Fall,	28.73	26.87	—1.86
1901, Spring,	27.59	28.71	+1.12

ANALYSES OF SPRING SAMPLES.

TABULATED ANALYSES OF COMMERCIAL FERTILIZERS

FROM

SAMPLES SELECTED BY SPECIAL AGENTS

OF THE

PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

Analyses by DR. WILLIAM FREAR, Chemist of the Department, and of the State College Experiment Station, State College, Pa.

SAMPLES SELECTED FROM JAN. 1, 1901, TO AUG. 1, 1901.

COMPLETE

Furnishing Phosphoric Acid,

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	THE ALLEGHENY CITY FERTILIZER WORKS, ALLLEGHENY, PA.		
429	†Pure Potato Manure,	Lewis Patterson, Slippery Rock,	9.12
760		Bloom & Kimball, Ebensburg,	
	THE AMERICAN AGRICULTURAL CHEMICAL CO., N. Y. BRADLEY BRANCH, BOSTON, MASS.		
324	†Bradley's Bean and Potato Phosphate,	Daniel Hinley, Myersburg,	10.03
685		Punxsutawney Hdw. Co., Punx'y,	
731		C. Marshall, Luthersburg,	
295	†Bradley's B. D. Sea Fowl Guano,	F. E. Barran, S. Montrose,	12.20
708		J. H. Sheffer, Knox,	
323	Bradley's Dissolved Bone with Potash,	Daniel Hinley, Wysox,	9.52
709		J. H. Sheffer, Knox,	
427	†Bradley's Niagara Phosphate,	Ephraim Adams, Wick,	9.25
707		J. H. Sheffer, Knox,	
294		F. E. Barron, South Montrose,	
733		C. Marshall, Luthersburg,	
815		C. B. Neiderheiser, Donegal,	
	CANTON CHEMICAL BRANCH, BALTIMORE, MD.		
397	†Canton Chemical Baker's Special Wheat, Corn and Grass Mixture,	Lemuel Campbell, Sunbury,	11.34
601		Josiah Specht, Kantner	
85		W. B. Winey, Middleburg,	
675		H. L. Stultz, Duncansville,	
723		McCullough & Co., Kittanning,	
796		King Bros., Uniontown,	
674	†Canton Chemical C. C. C. Special Compound,	H. L. Stultz, Duncansville,	10.67
455		H. M. Gray, Tyrone,	
795		King Bros., Uniontown,	
491	†Canton Chemical Eagle Phosphate,	S. N. Bailey & Bros., Dillsburg,	10.85
600		Josiah Specht, Kantner,	

For explanation of these tables see p. 713. †Composite sample.

FERTILIZERS.

Potash and Nitrogen.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
4.82	3.81	5.30	**13.93**	9.00	**8.63**	8.00	4.91	......	**4.91***	7.00	**2.70**	2.47	32.24	24.00	429
														24.00	760
5.98	2.65	1.94	**10.57**	9.00	**8.63**	8.00	4.22	......	**4.22**	4.00	**1.15**	.82	24.04	22.00	824
														28.00	685
														28.00	731
3.47	4.91	4.24	**12.62**	9.00	**8.38**	8.00	1.78	......	**1.78**	1.50	**2.26**	2.06	26.35	27.00	295
														28.00	706
4.36	4.93	2.81	**12.10**	9.00	**9.29**	8.00	2.64	......	**2.64**	2.00	**1.20**	1.03	23.62	21.00	323
														25.00	709
5.08	3.17	1.56	**9.81**	8.00	**8.25**	7.00	1.28	.....	**1.28**	1.00	**.97**	.82	19.65	22.00	427
														24.00	707
														20.00	294
														25.00	733
														20.00	815
6.81	2.48	1.61	**10.90**	10.00	**9.29**	9.00	2.17	......	**2.17**	2.00	**.85**	.82	21.49	20.00	397
														22.00	601
														20.00	85
														21.00	675
														23.00	723
														22.50	796
6.42	1.93	1.11	**9.46**	9.00	**8.35**	8.00	5.89	......	**5.89***	6.00	**1.89***	2.06	28.01	30.00	674
														32.00	455
														32.00	795
4.54	3.85	1.79	**10.18**	8.00	**8.30**	7.00	.80	.53	**1.33**	1.00	**.84**	.82	19.63	18.50	491
														20.00	600

For explanation of these tables see p. 713. †Composite sample.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
389	Canton Chemical Game Guano,	J. A. Romberger, Elizabethville,	12.05
395	†Canton Chemical Potato Manure,	Lemuel Campbell, Sunbury,	8.65
454		H. M. Gray, Tyrone,	
522		W. S. Weaver, Easton,	
84		W. B. Winey, Middleburg,	
544		Morris Nauman, Stroudsburg,	
668		Skyles, Miller & Co., Martinsburg,	
119	Canton Chemical Potato Manure (Complete Fertilizer, 1½x6x5),	J. W. Hostettler, Walnut,	6.40
888	Canton Chemical Resurgam Guano,	J. A. Romberger, Elizabethville,	9.70
676	†Canton Chemical Standard H. G. Guano,	H. L. Stultz, Duncansville,	10.42
798		King Bros., Uniontown,	
	CHICOPEE BRANCH, NEW YORK.		
662	Chicopee Farmer's Reliable Potato, Corn and Wheat Mixture,	H. B. Hickman & Son, W. Chester,	10.40
	CLARK'S COVE BRANCH, NEW YORK.		
9	†Clark's Cove King Philip Alkaline Guano,	C. J. Bushey, Mount Top,	9.05
403		A. Cameron Bobt, Paxinos,	
	CROCKER BRANCH, BUFFALO, N. Y.		
520	Crocker's Ammoniated Bone Phosphate,	Phineas Schneitzer Joanna,	11.61
305	Crocker's Ammoniated Bone Super Phosphate,	J. D. Diamond, Fairdale,	7.80
304	†Crocker's Ammoniated Wheat and Corn Phosphate	J. D. Diamond, Fairdale,	9.07
712		E. J. Hutchison, Polk,	
506	†Crocker's General Crop Phosphate,	Wm. R. Riland, DeTurksville,	10.88
697		J. T. Lock, Grove City,	
288	†Crocker's New Rival,	Wm. H. Riland, Friedensburg,	12.25
481		S. F. Miller, Mechanicsburg,	
719	Crocker's New Rival Ammoniated Super Phosphate,	W. R. Henderson, Hendersonville,	12.60
306	†Crocker's Potato, Hop, and Tobacco Fertilizer,	J. D. Diamond, Fairdale,	10.71
287		Wm. H. Riland, Friedensburg,	
480		S. F. Miller, Mechanicsburg,	
521		Phineas Schneitzer, Joanna,	
97	Crocker's Universal Grain Grower,	Ewing & Kinsloe, Newt. Hamilton,	4.42

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.				
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.	Computed commercial value of 2,000 pounds at Department rating. (See p. [illegible].)	Selling price of 2,000 pounds at the point of selection.	Sample number.
6.51	2.79	1.[illegible]0	**11.00**	9.00	**9.30**	8.00	2.27	......	**2.27**	2.00	**1.67**	1.65	24.67	21.00	359
														25.00	396
														26.00	454
3.75	2.26	1.59	**7.60**	7.00	**6.01**	6.00	5.35	......	**5.35**	5.00	**1.25**	1.24	22.36	25.00	622
														24.00	84
														25.00	544
														24.00	668
3.35	2.73	1.27	**7.35**	7.00	**6.08**	6.00	5.60	......	**5.60**	5.00	**1.30**	1.24	22.70	22.00	119
6.44	1.79	.88	**9.11**	9.00	**8.23**	8.00	1.47	2.89	**4.36**	4.00	**.90**	.82	22.90	20.00	358
5.10	3.44	1.86	**10.40**	9.00	**8.54**	8.00	3.36	......	**3.36**	3.00	**2.03***	2.06	26.43	25.00	676
														28.00	793
5.08	4.93	.47	**10.53**	8.00	**10.06**	7.00	1.39	......	**1.39**	1.00	**.67***	.82	20.06	22.50	652
6.22	2.26	.95	**9.43**	9.00	**8.48**	8.00	2.24	......	**2.24**	2.00	**.97***	1.03	20.73	20.00	9
														25.00	403
6.65	2.60	1.64	**10.89**	10.00	**9.25**	9.00	2.98	......	**2.98**	2.00	**2.36***	2.47	28.06	28.00	520
3.18	5.28	3.22	**11.68**	10.00	**8.46***	9.00	3.34	......	**3.34**	2.00	**2.38***	2.47	23.38	24.00	305
4.95	3.92	2.77	**11.64**	9.00	**8.87**	8.00	1.88	......	**1.88**	1.50	**2.19**	2.06	26.32	24.00	[illegible]
														26.00	712
4.39	2.93	2.01	**9.33**	8.00	**7.32**	7.00	2.40	......	**2.40**	1.00	**1.07**	.82	20.31	22.00	506
														23.00	697
7.83	2.47	1.43	**11.73**	10.00	**10.30**	9.00	2.13	......	**2.13**	2.00	**1.32**	1.24	24.36	25.00	288
														22.00	431
7.63	2.45	1.94	**12.02**	10.00	**10.08**	9.00	2.51	......	**2.51**	2.00	**1.50**	1.24	25.42	26.00	719
														26.00	306
														29.00	287
6.46	2.31	2.14	**10.91**	9.00	**8.77**	8.00	3.46	......	**3.46**	3.00	**2.04***	2.06	27.04	25.00	480
														30.00	521
3.13	4.25	2.39	**9.77**	9.00	**7.38***	8.00	2.41	......	**2.41**	2.00	**.98**	.82	20.16	22.50	27

For explanation of these tables see p. 713. †Composite sample.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	DETRICK BRANCH, BALTIMORE, MD.		
776	Detrick's Corn and Oats Fertilizer,	Newton Goudor, Jenners,	11.63
221	Detrick's Kangaroo Komplete Kompound,	G. B. Murphy, Keys,	10.02
113	Detrick's Imperial Compound,	James McCauley, Mifflintown,	7.10
114	Detrick's Paragon Ammoniated Bone Phosphate and Potash,	James McCauley, Mifflintown,	7.65
222	Detrick's Quick Step Bone Phosphate,	G. B. Murphy, Keys,	11.38
367	Detrick's Special Mixture,	E. E. Taylor, Newport,	5.28
613	Detrick's Standard Potash Fertilizer,	Newton Goudor, Jenners,	7.72
112	Detrick's Standard Potash Fertilizer (Complete Fertilizer, 1½x6x5 Standard Potash Fertilizer),	James McCauley, Mifflintown,	6.82
	GREAT EASTERN BRANCH RUTLAND, VERMONT.		
701	Great Eastern Complete Fertilizer,	Atwell & Perry, Big Bend,	9.50
539	†Great Eastern English Wheat Grower,	Chas. H. Kichline, Island Park,	8.24
750		U. S. Grumbling Elton,	
538	†Great Eastern Vegetable, Vine and Tobacco,	Chas. H. Kichline, Island Park,	12.05
315		M. A. Cramner, Monroeton,	
579		R. H. Morris, Danville,	
420	Great Eastern Wheat Grower,	Stout Bros., Valencia,	10.52
472	Great Eastern Wheat Special,	L. T. Weller, E. Troy,	10.77
	LAZARETTO BRANCH, BALTIMORE, MD.		
228	Lazaretto Ammoniated Bone Phosphate,	Grove & Uffelman, Brogueville,	12.40
173	Lazaretto Crop Grower,	S. K. Chambers & Bro., W. Grove,	9.53
484	Lazaretto Special for Tobacco and Potatoes,	D. A. Urich, Mechanicsburg,	10.61
485	Lazaretto Special Potato Fertilizer,	D. A. Urich, Mechanicsburg,	10.43
	MARYLAND, BRANCH, BALTIMORE, MD.		
480	Maryland Ammoniated,	J. B. Zimmerman, Mechanicsburg,	9.40
565	Maryland Special Compound for Potatoes and Tobacco,	Jno. G. Simpson, Huntingdon,	8.23
	MILSOM BRANCH, EAST BUFFALO, N. Y.		
706	†Milsom's Buffalo Fertilizer,	G. B. Miller, Kossuth,	8.61
717		Hetterbaugh & Downs, Sandy Lake,	
261	†Milsom's Buffalo Guano,	Jacob Hollenbaugh, Hamburg,	10.82
718		Hetterbaugh & Downs, Sandy Lake,	

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
6.52	2.98	1.37	**10.87**	10.00	**9.50**	9.00	3.01	......	**3.01**	3.00	**.93**	.82	22.80	22.00	776
5.87	2.72	2.54	**11.13**	9.00	**8.59**	8.00	3.07	......	**3.07**	3.00	**1.68**	1.65	25.26	21.00	221
5.49	3.14	1.16	**9.79**	9.00	**8.63**	8.00	2.25	......	**2.25**	2.00	**.87**	.82	20.52	20.00	113
6.31	2.20	1.02	**9.53**	8.00	**8.51**	7.00	1.21	......	**1.21**	1.00	**.88**	.82	19.52	18.00	111
6.89	2.98	1.31	**11.18**	9.00	**9.87**	8.00	4.38	......	**4.38**	4.00	**2.34***	2.47	30.06	25.00	222
3.76	5.44	1.77	**10.97**	9.00	**9.20**	8.00	1.09	......	**1.09**	1.00	**.90**	.82	20.22	17.50	367
3.74	2.61	1.48	**7.83**	7.00	**6.35**	6.00	5.80	......	**5.80**	5.00	**1.50**	1.24	24.10	23.00	613
3.09	2.96	1.31	**7.36**	7.00	**6.05**	6.00	5.39	......	**5.39**	5.00	**1.34**	1.24	22.63	22.00	112
5.73	4.94	1.26	**11.93**	......	**10.67**	......	2.00	.32	**2.32**	......	**.38**	......	15.[illegible]1	22.50	701
4.72	3.49	1.59	**9.80**	9.00	**8.21**	8.00	2.29	......	**2.29**	2.00	**.98**	.82	20.78	22.00	539
														28.00	730
6.84	2.44	1.59	**10.87**	9.00	**9.28**	8.00	3.47	......	**3.47**	3.00	**2.09**	2.06	27.60	28.50	538
														....	315
														28.00	57
4.75	4.11	3.10	**11.96**	9.00	**8.86**	8.00	2.68	......	**2.68**	2.00	**1.40***	1.65	24.15	23.00	420
6.56	2.86	2.09	**11.51**	9.00	**9.42**	8.00	2.42	......	**2.42**	2.00	**1.83**	1.65	25.90	20.00	472
7.39	2.70	1.20	**11.29**	9.00	**10.09**	8.00	2.10	......	**2.10**	2.00	**.89**	.82	22.38	18.00	228
6.04	2.20	2.98	**11.22**	9.00	**8.24**	8.00	2.27	......	**2.27**	2.00	**1.85**	1.65	24.85	21.00	173
6.78	1.83	1.88	**10.49**	9.00	**8.61**	8.00	3.76	......	**3.76**	3.00	**2.52**	2.47	28.88	26.00	484
6.48	1.89	.93	**9.30**	9.00	**8.37**	8.00	4.12	......	**4.12**	4.00	**.93**	.82	22.52	23.00	485
6.68	2.09	2.46	**11.23**	9.00	**8.77**	8.00	3.13	......	**3.13**	3.00	**1.67**	1.65	25.44	....	489
6.67	1.78	.90	**9.35**	9.00	**8.45**	8.00	11.58	......	**11.58**	10.00	**1.59***	1.65	32.73	30.00	565
4.13	5.29	3.19	**12.61**	9.00	**9.42**	8.00	1.95	......	**1.95**	1.50	**2.29**	2.00	27.40	25.00	706
														26.00	717
5.45	3.08	1.45	**9.98**	......	**8.53**	......	3.76	......	**3.76**	......	**.92**	......	22.27	19.00	260
														25.00	718

For explanation of these tables see p. 713. †Composite sample.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
[illegible]	Milsom's Corn Fertilizer,	J. H. Eddinger, Luthersburg,	10.26
[illegible]	†Milsom's Erie King,	G. B. Miller, Kossuth,	8.64
[illegible]		J. H. Eddinger, Luthersburg,	
[illegible]	†Milsom's Potato, Hop and Tobacco Phosphate,	Hetterbaugh & Downs, Sandy Lake,	9.42
[illegible]		J. H. Eddinger, Luthersburg,	
[illegible]	†Milsom's Wheat, Oats and Barley,	Hetterbaugh & Downs, Sandy Lake	8.51
[illegible]		G. B. Miller, Kossuth,	
[illegible]		J. H. Eddinger, Luthersburg,	
	MORO-PHILIPS BRANCH, PHILADELPHIA.		
[illegible]	†Moro-Philips Farmer's Phosphate,	D. S. Potteiger, Hamburg,	10.52
[illegible]		Paul S. Lenger, Pine Grove,	
[illegible]	Moro-Philips Farmer's Potato Mixture,	W. H. Matlack & Co., W. Chester,	10.88
	NIAGARA BRANCH, BUFFALO, N. Y.		
711	Niagara Wheat and Corn Producer,	[illegible] I. McDowell, Knox,	8.55
	PACIFIC GUANO BRANCH, NEW YORK.		
[illegible]	Pacific Guano A No. 1 Phosphate,	A. I. Super, Friedensburg,	10.68
	PACKER'S UNION BRANCH, RUTLAND, VT.		
346	†Packer's Union American Wheat and Rye Grower,	Frank Wion, Bellefonte,	8.72
17		J. W. Gladfelter, Rossville,	
[illegible]		William Weller, Husband,	
[illegible]		R. C. Heffley, Berlin,	
611	†Packer's Union Animal Corn Fertilizer,	N. D. Bowman, Critchfield,	10.63
[illegible]		A. A. Stark, West Nicholson,	
[illegible]		Grant Snowberger, Freedom,	
[illegible]		T. McCartney, Farmington,	
[illegible]	Packer's Union Complete Fertilizer,	G. H. Hinckley, West Nicholson,	6.06
[illegible]	Packer's Union Complete Fertilizer (Gardeners),	A. A. Stark, West Nicholson,	5.43
[illegible]	Packer's Union Animal Corn Fertilizer,	Fred. Barney, East Troy,	13.34
[illegible]	†Packer's Union Potato Manure,	W. H. McMahon, Leona,	12.62
[illegible]		Fred. Varney, East Troy,	
[illegible]		Grant Snowberger, Freedom,	
[illegible]	†Packer's Union Universal Fertilizer,	A. A. Stark, West Nicholson,	8.18
[illegible]		R. C. Heffley, Berlin,	

For explanation of these tables see p. 713. †Composite sample

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Present as muriate.	Present as sulphate.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.			
6.9[illegible]	2.45	1.[illegible]	10.49	10.00	9.43	9.00	2.29	......	2.29	2.00	2.26*	2.47	26.95	29.00	725
5.12	3.32	1.35	9.79	8.00	8.44	7.00	1.12	......	1.12	1.00	1.00	.82	19.76	22.00	704
														22.00	723
6.35	2.62	3.09	12.09	9.00	9.00	8.00	3.16	......	3.16	3.00	2.01*	2.06	27.27	28.00	715
														28.00	727
5.22	4.2[illegible]	1.57	11.02	9.00	9.45	8.00	2.26	......	2.26	2.00	.99	.82	22.11	[illegible]	714
														23.50	705
														23.00	726
4.98	2.15	1.49	8.62	8.00	7.13	7.00	1.44	......	1.44	1.00	.89	.82	18.32	17.00	255
														18.00	507
3.50	2.37	1.87	7.74	7.00	5.87*	6.00	4.97	......	4.97*	5.00	1.31	1.24	22.12	23.00	655
4.81	5.27	1.91	11.99	10.00	10.08	9.00	2.28	......	2.28	2.00	1.41	1.24	24.52	25.00	711
4.84	2.36	1.44	8.64	8.00	7.20	7.00	1.20	......	1.20	1.00	.87	.82	17.95	20.00	280
5.81	2.70	1.01	9.52	9.00	8.51	8.00	2.30	......	2.30	2.00	.83	.82	20.37	18.00	343
														19.00	17
														20.00	617
														20.00	627
7.64	1.51	1.53	10.68	10.00	9.15	9.00	2.56	......	2.56	2.00	2.16*	2.47	26.80	25.00	611
														27.50	134
														30.00	680
														26.00	794
5.65	1.11	1.30	8.06	......	6.76	......	2.00	7.97	9.97	......	3.27	......	37.05	35.00	132
5.72	1.10	1.24	8.06	7.00	6.82	6.00	2.00	8.54	10.54	10.00	3.46	3.30	33.58	35.00	133
7.57	2.47	1.76	11.80	10.00	10.04	9.00	3.42	......	3.42	2.00	2.46*	2.47	29.89	....	468
7.20	2.16	1.31	10.67	9.00	9.36	8.00	6.12	......	6.12	6.00	2.11	2.06	30.28	23.00	473
														....	466
														30.00	679
7.12	1.90	1.48	10.40	9.00	8.92	8.00	4.96	......	4.96	4.00	.87	.82	23.90	21.50	126
														22.00	625

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
135	Packer's Union American Wheat and Rye Grower, ...	A. A. Stark, West Nicholson, ...	8.92
	QUINNIPIAC BRANCH, NEW YORK.		
542	Quinnipiac Ammoniated Dissolved Bone, ...	A. J. Wolfe, East Stroudsburg, ...	13.61
5	†Quinnipiac Climax Phosphate, ...	Pax'n Fl. & F'd Co., Bowmansdale,	10.37
785		J. M. Fike, Bills, ...	
6	Quinnipiac Mohawk Fertilizer, ...	Pax'n Fl. & F'd Co., Bowmansdale,	8.20
7	†Quinnipiac Special Potato, ...	Pax'n Fl. & F'd. Co., Bowmansdale,	8.15
541		A. J. Wolfe, East Stroudsburg, ..	
	READ BRANCH, NEW YORK, N. Y.		
266	†Read's Leader Blood and Bone, ...	Andrew J. Potts, Orwigsburg, ...	[illegible]
528		N. M. Gehman, Macungie, ...	
	REESE BRANCH, BALTIMORE, MD.		
152	Reese's Ammoniated Bone Phosphate Mixture, ...	Ball & Rhodes, Media, ...	12.40
150	Reese's Potato Manure, ...	Ball & Rhodes, Media, ...	8.07
153	Reese's Standard, ...	Ball & Rhodes, Media, ...	13.02
	SHARPLESS & CARPENTER BRANCH, PHILA.		
157	Sharpless & Carpenter's Dissolved Bone Phosphate (for Potatoes and General Use), ...	J. J. White, Lansdale, ...	11.75
158	†Sharpless & Carpenter's Farmer's Bone Phosphate	J. J. White, Lansdale, ...	8.04
512		A. Kerschner, Rock, ...	
179	†Sharpless & Carpenter's Gilt Edge Potato and Tobacco Manure, ...	E. A. & J. L. Pennock, Chatham,	9.53
161		J. Watson Kraft, Ambler, ...	
247		Geo. K. Linderman, Birdsboro, ...	
160	Sharpless & Carpenter's No. 1 Bone Phosphate, ...	J. J. White, Lansdale, ...	11.34
245	†Sharpless & Carpenter's Potato, Corn and Truck Guano, ...	L. A. Geiger, Joanna, ...	9.18
159		J. J. White, Lansdale, ...	
248		Geo. K. Linderman, Birdsboro, ...	
211	†Sharpless & Carpenter's Royal Spring Mixture, ..	Geo. K. Linderman, Geigertown, ..	9.69
163		J. Watson Kraft, Ambler, ...	
244		L. A. Geiger, Joanna, ...	

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
7.23	2.07	2.30	11.60	9.00	9.30	8.00	2.95	......	2.95	[illegible]	1.19	.82	24.04	25.00	[illegible]
5.93	2.71	1.78	10.42	9.00	8.64	8.00	2.84	......	2.84	[illegible]	1.58*	1.65	24.34	25.00	[illegible]
7.11	2.10	.77	9.98	9.00	9.21	8.00	2.18	......	2.18	[illegible]	1.04	1.03	21.85	22.00	[illegible]
														20.85	[illegible]
5.73	2.81	.92	9.46	8.00	8.54	7.00	1.19	......	1.19	[illegible]	.85	.82	19.21	20.00	[illegible]
4.17	2.04	1.79	8.00	7.00	6.21	6.00	5.25	......	5.25	5.00	1.35	[illegible]	23.00	27.00	[illegible]
														25.00	[illegible]
4.55	2.75	1.65	8.95	8.00	7.30	7.00	1.74	......	1.74	1.00	.86	.82	18.68	17.00	[illegible]
														20.00	[illegible]
5.72	2.82	3.30	11.84	10.00	8.54*	9.00	3.18	......	3.18	3.00	.98	.82	23.01	25.00	[illegible]
6.28	2.45	3.09	11.82	10.00	8.73*	9.00	8.00	......	8.00	7.00	.94	.82	27.85	28.00	[illegible]
7.43	2.39	1.82	11.64	10.00	9.82	9.00	1.86	.42	2.28	2.00	2.45*	2.47	28.63	28.00	[illegible]
7.13	1.67	1.95	10.75	9.00	8.80	8.00	6.05	......	6.05	6.00	2.03*	2.06	29.74	....	157
5.60	2.81	2.13	10.54	9.00	8.41	8.00	3.88	......	3.88*	4.00	1.04	.82	23.19	....	158
														22.00	512
														28.00	179
6.34	2.07	1.67	10.08	9.00	8.41	8.00	9.12	......	9.12*	10.00	1.64*	1.65	30.70	27.00	164
														28.00	247
6.46	1.87	2.31	10.64	9.00	8.33	8.00	2.43	......	2.43	2.00	1.82	1.65	24.70	....	160
														22.00	245
3.96	2.01	2.04	8.01	7.00	5.97*	6.00	5.45	......	5.45	5.00	1.24	1.24	22.61	....	159
														22.50	248
														20.00	241
6.16	2.05	1.77	9.98	9.00	8.21	8.00	2.19	......	2.19	2.00	.93	.82	20.76	19.00	163
														20.00	244

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	STANDARD BRANCH, NEW YORK.		
257	Standard A Fertilizer,	F. H. Reutschler, Hamburg,	10.88
256	Standard Potato Grower,	F. H. Reutschler, Hamburg,	10.11
	SUSQUEHANNA BRANCH, BALTIMORE, MD.		
311	Susquehanna Crop Grower,	B. A. Cranmer, Monroeton,	11.65
200	†Susquehanna Potato Phosphate,	Henry Sundy, East Berlin,	9.19
53		Geo. B. Passmore & Sons, Oxford,	
310		B. A. Cranmer, Monroeton,	
116	Susquehanna Potato Phosphate (Complete Fertilizer, 2x8x5),	W. V. Shirk, Oakland Mills,	7.32
118	Susquehanna XXV Phosphate,	W. V. Shirk, Oakland Mills,	11.50
199	†Susquehanna XXV Phosphate,	Henry Sundy, East Berlin,	10.94
261		Solomon H. Lenhart, Hamburg,	
	TYGERT-ALLEN BRANCH, PHILA., PA.		
458	Allen's Ammoniated Bone Phosphate,	Sudeker & Mitchell, Troy,	7.51
622	†Allen's Popular Phosphate,	C. F. Raymond, Pugh,	11.04
319		J. L. Ward, Monroeton,	
644		A. F. Swank, Hollsopple,	
457	†Allen's Special Brand Potato Manure,	Sudeker & Mitchell, Troy,	11.37
534		J. Lingmaster & Co., Macungie,	
645	†Allen's Special for Wheat and Clover,	A. F. Swank, Hollsopple,	9.18
531		J. Lingmaster & Co., Macungie,	
793		Wm. Conoway, Markleysburg,	
532	†Allen's Star Potato Grower,	J. Lingmaster & Co., Macungie,	8.57
616		A. F. Swank, Hollsopple,	
	WHEELER BRANCH, RUTLAND, VERMONT.		
302	[illegible] Fertilizer,	T. A. Roberts, East Rush,	10.42
412		E. H. Crawford, Foxburg,	
741		W. S. Cobaugh, Vinco,	
800		C. E. Watrons, Dimock,	
230		H. W. Chaffer, Porterville,	
771		Jno. S. Wetsell, Carrolltown,	

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
4.53	2.59	2.06	9.23	8.00	7.17	7.00	1.56	......	1.56	1.00	.84	.82	18.56	20.00	257
3.66	2.55	2.20	8.41	7.00	6.21	6.00	5.68	......	5.68	5.00	1.16*	1.24	22.83	25.00	159
5.49	3.13	2.42	11.04	8.00	8.62	7.00	1.36	......	1.36	1.00	.96	.82	20.59	19.00	211
4.07	3.33	2.73	10.13	9.00	7.40*	8.00	4.88	......	4.88*	5.00	1.58*	1.65	25.35	25.50	200
														25.00	53
														26.00	210
4.18	3.06	3.09	10.33	9.00	7.24*	8.00	4.83	......	4.83*	5.00	1.58*	1.65	25.32	25.00	116
6.45	2.74	2.82	12.01	9.00	9.19	8.00	1.38	......	1.38	1.00	1.03	.82	21.92	18.50	118
6.03	2.60	1.94	10.57	9.00	8.63	8.00	1.34	......	1.34	1.00	1.01	.82	20.56	20.50	199
														23.00	261
6.23	3.50	1.40	11.13	......	9.73	......	1.30	......	1.30	......	1.03	......	21.72	28.00	458
7.16	2.12	1.30	10.58	9.00	9.28	8.00	2.30	......	2.30	2.00	.94	.82	21.93	18.00	[illegible]
														21.00	319
														18.50	644
5.65	2.22	1.80	9.67	9.00	7.87*	8.00	6.28	......	6.28	6.00	1.97*	2.06	28.34	28.00	457
														27.00	534
5.36	2.55	1.49	9.40	8.00	7.91	7.00	1.32	......	1.32	1.00	.89	.82	19.09	17.50	646
														19.00	531
														17.00	798
3.85	2.26	1.74	7.85	7.00	6.11	6.00	4.42	......	4.42*	5.00	1.20*	1.24	21.39	23.00	532
														23.00	646
5.98	3.11	2.36	11.45	9.00	9.09	8.00	2.54	......	2.54	2.00	1.84	1.65	25.78	25.00	802
														22.00	412
														27.00	741
														18.00	800
														22.00	239
														27.00	771

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
[illegible]	†Wheeler's Potato Manure,	H. W. Chaffer, Porterville,	11.05
298		W. A. Fish, S. Monrose,	
742		W. S. Cobaugh, Vinco,	
[illegible]	†Wheeler's Royal Wheat Grower,	E. H. Crawford, Foxburgh,	8.94
[illegible]		Parker Speicher, Somerset,	
	WILLIAMS & CLARK BRANCH, NEW YORK.		
690	Williams & Clark's American Prolific Crop Producer,	M. I. Montgomery, Grove City,	7.33
688	†Williams & Clark's Good Grower Potato Phosphate,	Reynoldsville Hd. Co., Reynolds'lle,	8.43
[illegible]		H. S. Tressler, Newport,	
651		M. I. Montgomery, Grove City,	
[illegible]		J. M. Fike, Bills,	
642	†Williams & Clark's Prolific Fertilizer,	Jacob Kauffman, Jr., Davidsville,	8.81
724		Reynoldsville Hd. Co., Reynolds'lle,	
[illegible]	†Williams & Clark's Royal Bone Phosphate,	Reynoldsville Hd. Co., Reynolds'lle,	10.43
643		Jacob Kauffman, Jr., Davidsville,	
692		M. I. Montgomery, Grove City,	
	AMERICAN REDUCTION CO., PITTSBURG, PA.		
687	†Common Sense,	W. K. Fetzer, Brookville,	8.96
779		J. E. Weaver, Davidsville,	
438		A. M. McClure, Everett,	
813		Eicher & Graft, Scottdale,	
817		Harvey Black, Ligonier,	
816	†Iron City,	W. K. Fetzer, Brookville,	12.77
656		Harvey Black, Ligonier,	
778	Vegetable Manure,	J. E. Weaver, Davidsville,	10.84
	THE ARMOUR FERT. WORKS, CHICAGO, ILL.		
352	†All Soluble,	McCalmont & Co., Bellefonte,	7.97
672		J. E. Hagy, Henrietta,	
[illegible]	Bone, Blood and Potash,	McCalmont & Co., Bellefonte,	3.56

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
6.42	2.88	2.16	11.46	9.00	9.30	8.00	3.74	......	3.74	3.00	2.01*	2.06	27.75	28.00	329
														26.00	298
														28.00	742
6.48	2.31	1.70	10.49	9.00	8.79	8.00	2.11	......	2.11	2.00	1.01	.82	21.49	23.00	409
														18.00	615
2.63	4.35	3.31	10.28	8.00	6.97*	7.00	1.02	......	1.02	1.00	1.06	.82	18.92	20.00	690
4.52	2.49	2.18	9.19	7.00	7.01	6.00	5.42	......	5.42	5.00	1.35	1.24	24.25	25.00	688
														24.00	365
														22.50	691
														22.30	782
4.48	3.54	2.05	10.07	8.00	8.02	7.00	1.25	......	1.25	1.00	1.01	.82	19.68	23.00	642
														21.00	724
5.70	3.58	1.72	11.00	9.00	9.28	8.00	2.27	......	2.27	2.00	.98*	1.03	22.08	22.00	689
														26.00	613
														23.00	692
4.08	4.43	1.65	10.16	.....	8.51	6.00	.84	......	.84*	1.00	1.55*	1.65	21.68	22.00	687
														17.00	779
														18.00	438
														18.00	813
														18.00	817
5.65	2.78	1.22	9.65	......	8.43*	9.00	2.41	......	2.41	2.00	2.50	2.47	26.83	25.00	686
														22.00	816
4.52	2.18	1.77	8.47	......	6.70	6.00	3.60	3.29	6.89	6.00	2.96	2.47	31.98	28.60	778
4.01	3.41	4.7[illegible]	12.21	10.00	7.45*	8.00	.53	3.85	4.38	4.00	3.10	2.68	32.32	32.00	352
														30.00	672
3.19	4.88	102	9.09*	10.00	8.07	8.00	1.47	5.56	7.03	7.00	4.12	4.12	37.95	39.00	349

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
736		J. P. Staver, Clearfield, ...	
527	†Fruit and Root Crop Special, ...	W. M. Gehman, Macungie, ...	7.71
757		Wallace Sherline, Willmore, ...	
351		McCalmont & Co., Bellefonte, ...	
369		J. L. Ritter & Sons, Newport, ...	
413		Jno. S. Harshberger, Everett, ...	
493		Cook, Deardorff & Co., Dillsburg, ..	
82		L. Painter, Red Top, ...	9.23
525	†Grain Grower, ...	W. M. Gehman, Macungie, ...	
574		E. A. Slagle, Paxinos, ...	
603		Cook & Beerits, Stoyestown, ...	
628		Simon N. Frets, Garrett, ...	
673		J. E. Hagey, Henrietta, ...	
526		W. M. Gehman, Macungie, ...	
256	†High Grade Potato Fertilizer, ...	S. G. Updegraff, Williamsport, ...	7.60
806		Crawford & Co., Greensboro, ...	
414	Phosphate and potash, ...	Stroup Bros., Valencia, ...	6.61
240	Tobacco Special, ...	R. A. Lentz, Red Lion, ...	10.28
216		Dotteras & Easley, Hanover, ...	
348		McCalmont & Co., Bellefonte, ...	
368		J. L. Ritter & Son, Newport, ...	
601		Cook & Beerits, Stoyestown, ...	
83	†Wheat, Corn and Oats Special, ...	L. Painter, Red Top, ...	7.92
735		J. P. Staver, Clearfield, ...	
756		Wallace Sherline, Willmore, ...	
814		Smith & Son, Mount Pleasant, ...	
	R. S. AUCKER, SHAMOKIN, PA.		
96	Grade "C" Bone and Slaughter House Phosphate, ...	....	5.62
94	Grade "D" Bone and Slaughter House Phosphate, ...	Geo. R. Hendricks, Selinsgrove, ...	5.71
95	Grade "E" Bone and Slaughter House Phisphate, ...	Geo. R. Hendricks, Selinsgrove, ...	6.44
287	Pure Bone Meal with Potash, ...	Geo. R. Hendricks, Selinsgrove, ...	7.46

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Present as muriate.	Present as sulphate.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.			
														30.00	736
4.28	4.71	2.48	11.57	10.00	9.09	8.00	5.24	......	5.24	5.00	1.98	1.65	28.96	26.00	527
														28.00	757
														24.00	251
														[illegible]	[illegible]
														[illegible]	[illegible]
														[illegible]	[illegible]
6.49	2.93	1.90	11.32	10.00	9.42	8.00	2.35	......	2.35	2.00	1.73	1.65	25.36	[illegible]	[illegible]
														[illegible]	[illegible]
														[illegible]	[illegible]
														[illegible]	[illegible]
														[illegible]	[illegible]
														[illegible]	[illegible]
														[illegible]	[illegible]
6.21	3.77	1.61	11.59	10.00	9.98	8.00	2.53	6.63	9.16*	10.00	1.70	1.65	33.78	32.00	356
														30.00	806
4.80	3.54	6.66	15.00	12.00	8.34*	10.00	3.32	......	3.32	2.00	2.67	......	30.74	[illegible]	[illegible]
5.35	3.32	2.49	11.16	......	8.67	......	1.33	3.05	4.38	......	2.16	......	28.88	[illegible]	[illegible]
														[illegible]	[illegible]
														[illegible]	[illegible]
														[illegible]	[illegible]
														[illegible]	[illegible]
3.96	4.81	2.28	11.05	9.00	8.77	7.00	1.44	......	1.44	1.00	1.14	.82	21.32	[illegible]	[illegible]
														[illegible]	[illegible]
														21.00	[illegible]
														[illegible]	814
3.64	3.48	1.98	9.10*	10.14	7.12*	8.45	3.40	......	3.40	3.25	1.01	.87	20.80	....	93
3.95	3.40	1.73	9.08	9.00	7.35	7.00	3.35	......	3.35	2.00	.83	.74	20.34	20.00	94
3.96	3.09	1.54	8.59*	9.00	7.05	7.00	2.59	......	2.59	2.50	.72	.62	18.57	18.00	95
.....	5.23	8.05	13.36*	17.54	5.28*	9.38	[illegible]	......	3.99*	4.57	2.56*	2.57	27.36	[illegible]	[illegible]

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	BALTIMORE PULVERIZING CO., BALTIMORE, MD.		
488	†Farmer's Favorite Fertilizer, F. F. F.,	R. P. Henderson, Carlisle,	5.75
618		Cyrus Berkeyville, Buckstown,	
569	Special Potato Mixture,	Sam'l. Witsell, Mill Creek,	6.65
	BAUGH & SONS CO., PHILADELPHIA, PA.		
606	†Corn Fertilizer for Sugar Corn and Garden Truck	Peter J. Blough, Hooversville,	13.04
214		Sheffer & Fry, Hanover,	
801		A. Gaddis & Co., Uniontown,	
435	†Double Eagle Phosphate,	A. M. McClure, Everett,	12.52
239		Geo. Holtzinger, Red Lion,	
788		F. W. Mason, Glade,	
791		M. R. Thomas, Somerfield,	
607	†Export Bone with Potash,	P. J. Blough, Hooversville,	6.65
210		J. U. Ruff, New Oxford,	
802		A. Gaddis & Co., Uniontown,	
238	†General Crop Grower for all Crops,	Geo. Holtzinger, Red Lion,	11.[illegible]2
434		A. M. McClure, Everett,	
147		C. F. Williamson, Media,	
608		P. J. Blough, Hooversville,	
751		Jacob Statler, Elton,	
803		A. Gaddis & Co., Uniontown,	
207	High Grade Potato Guano,	J. U. Ruff, New Oxford,	10.61
609	Potato Fertilizer,	P. J. Blough, Hooversville,	10.83
149	†Special Potato Manure,	C. F. Williamson, Media,	10.55
752		Jacob Statler, Elton,	
148	$25 Phosphate,	C. F. Williamson, Media,	11.23
	BERGER BROS., EASTON, PA.		
536	Lehigh Superphosphate,	W. S. Weaver, Easton,	9.24
[illegible]	[illegible]	W. S. Weaver, Easton,	13.37
	THE BERG CO., PHILADELPHIA, PA.		
155	Pure Dissolved Bone and Potash for Wheat and Grass,	Ball & Rhodes, Media,	7.96

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds. Soluble in water.	Phosphoric Acid in 100 Pounds. Reverted.	Phosphoric Acid in 100 Pounds. Insoluble.	Phosphoric Acid in 100 Pounds. Total. Found.	Phosphoric Acid in 100 Pounds. Total. Guaranteed.	Phosphoric Acid in 100 Pounds. Available. Found.	Phosphoric Acid in 100 Pounds. Available. Guaranteed.	Potash in 100 Pounds. (Water Soluble.) Present as muriate.	Potash in 100 Pounds. (Water Soluble.) Present as sulphate.	Potash in 100 Pounds. (Water Soluble.) Total. Found.	Potash in 100 Pounds. (Water Soluble.) Total. Guaranteed.	Nitrogen in 100 Pounds. Found.	Nitrogen in 100 Pounds. Guaranteed.	Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
1.88	5.13	1.71	**8.72**	.....	**7.01**	5.25	1.88	.....	**1.88***	3.25	**.97**	.82	18.00	18.00	488
														17.00	613
2.90	2.97	1.56	**7.43**	.....	**5.87**	.....	4.29	.....	**4.29**	.....	**1.71**	.....	22.78	21.00	569
														23.00	606
6.55	3.40	1.65	**11.60**	.....	**9.95**	8.00	4.11	.....	**4.11**	4.00	**.89**	.82	21.37	22.00	214
														21.00	861
														24.00	425
4.71	4.21	2.41	**11.33**	.....	**8.92**	8.00	1.33	.....	**1.33**	1.00	**1.68**	1.65	23.70	24.00	233
														21.60	788
														24.00	791
														28.00	667
.70	4.91	6.67	**12.28**	11.00	**5.61**	.....	2.42	.....	**2.42**	2.00	**2.01**	1.65	24.07	25.00	210
														25.00	862
														19.00	238
														20.00	434
														18.00	147
6.02	3.02	1.81	**10.85**	.....	**9.04**	8.00	1.68	.....	**1.68**	1.00	**1.08**	.82	21.73	21.00	608
														20.00	751
														19.00	803
4.84	2.66	1.56	**9.06**	.....	**7.50**	.....	6.86	.....	**6.86**	.....	**3.52**	.....	31.26	30.00	207
5.58	3.47	1.95	**11.00**	.....	**9.05**	8.00	2.09	.....	**2.09**	2.00	**2.30**	1.65	26.77	25.00	649
3.27	3.49	2.09	**8.85**	.....	**6.76**	5.00	9.07	2.13	**11.20**	10.00	**1.88**	1.65	32.19	27.00	149
														29.00	752
5.54	3.31	2.05	**10.90**	.....	**8.85**	8.00	1.31	.....	**1.31**	1.00	**1.70**	1.65	23.47	22.00	148
4.64	3.18	2.91	**10.76**	9.50	**7.82***	8.50	6.28	.....	**6.28**	5.50	**1.63***	1.65	27.57	27.50	536
5.53	5.26	1.84	**9.63***	10.00	**7.79***	8.00	2.53	.....	**2.53**	2.00	**1.15**	.82	21.04	20.00	537
6.01	3.11	4.35	**12.47**	.....	**8.12***	9.00	5.36	.....	**5.36**	3.50	**1.98***	3.00	28.98	27.00	155

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	BOWKER FERTILIZER CO., BOSTON & NEW YORK.		
391		S. & J. W. Stroh, Sunbury, ...	
336	†Ammoniated O. I. O. Phosphate, ...	P. H. Taylor, Wysox, ...	11.59
518		F. L. Wagner, Hamburg, ...	
552	Farm and Garden Phosphate, ...	Bailey & Converse, Wellsboro, ...	15.60
575	Hill and Drill Phosphate, ...	J. H. Kase, S. Danville, ...	13.29
703	Potash or Staple Phosphate, ...	G. E. Kline, Lamartine, ...	12.00
359		Bailey & Converse, Wellsboro, ...	
162	†6 per cent. Potash Fertilizer, ...	J. G. Hackman, Lansdale, ...	14.34
682		Wrigley H'dware Co., Mahaffey, ...	
577	Stockbridge Manure, ...	J. H. Kase, S. Danville, ...	10.03
250		Kauffman & Lutz, Geigertown, ...	
334		P. H. Taylor, Wysox, ...	
354		Central Commission Co., W'msport,	
399		Bailey & Converse, Wellsboro, ...	
161	†Sure-Crop Phosphate, ...	J. G. Hackman, Lansdale, ...	14.83
390		S. & J. W. Stroh, Sunbury, ...	
463		H. M. Spalding & Son, Troy, ...	
576		J. H. Kase, S. Danville, ...	
683		Wrigley H'dware Co., Mahaffey, ..	
465	Tobacco Ash, ...	H. M. Spalding & Son, Troy, ...	4.55
	BRUMFIELD & FOSTER, COLORA, MD.		
71	Potato Phosphate, ...	Wilson & Mende'all, Toughkenamon	6.69
	CAMBRIA FERTILIZER CO., JOHNSTOWN, PA.		
769	B. & B. Phosphate, ...	Jno. S. Wetsell, Carrolltown, ...	6.79
677	†Corn and Potato Manure, ...	Jas. McMasters, Newry, ...	8.33
761		H. A. Shoemaker, Ebensburg, ...	
764	Lion Ammoniated Bone Phosphate, ...	H. A. Shoemaker, Ebensburg, ...	7.75
762	†Standard Phosphate, ...	H. A. Shoemaker, Ebensburg, ...	5.14
770		Jno. S. Wetsel, Carrolltown, ...	
	CHICAGO FERTILIZER CO., CHICAGO, ILL.		
681	Wheat Special, ...	W. F. Spidel, Hollidaysburg, ...	8.07

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
														[illegible]	[illegible]
3.83	6.63	3.71	14.17	......	10.46	10.00	.38	......	.38	......	.94	[illegible]	[illegible]	......	[illegible]
														[illegible]	[illegible]
4.87	4.01	2.70	11.58	......	8.88*	9.00	2.28	......	2.28	2.00	1.54	1.50	[illegible]	[illegible]	[illegible]
5.96	3.25	2.64	11.85	......	9.21	9.00	2.26	......	2.26	2.00	2.53	2.25	[illegible]	[illegible]	[illegible]
2.64	6.08	2.56	11.28	......	8.72	8.00	1.33	1.75	3.08	3.00	.87	.75	[illegible]	[illegible]	[illegible]
														[illegible]	[illegible]
1.31	3.61	1.81	9.73	......	7.92	6.00	5.38	......	5.38*	6.00	.79	.75	[illegible]	30.00	[illegible]
														35.00	[illegible]
4.70	2.63	2.70	10.03	......	7.33	6.00	10.73	......	10.73	10.00	3.29	3.20	[illegible]	40.00	[illegible]
														[illegible]	[illegible]
														......	[illegible]
														[illegible]	[illegible]
														[illegible]	[illegible]
4.67	4.49	2.17	11.33	......	9.16	9.00	2.25	......	2.25	2.00	.82	.75	[illegible]	[illegible]	[illegible]
														[illegible]	[illegible]
														[illegible]	[illegible]
														[illegible]	576
														[illegible]	[illegible]
.20	6.35	5.78	12.33	......	6.55	......	......	13.87	13.87	......	3.87	......	[illegible]	[illegible]	[illegible]
4.29	1.75	2.97	9.01	......	6.04	......	5.27	......	5.27	......	1.63	......	[illegible]	22.00	71
1.76	2.48	1.40	5.64*	8.00	4.24*	6.50	2.98	......	2.98	2.00	1.30	1.00	[illegible]	[illegible]	[illegible]
														[illegible]	[illegible]
4.96	2.39	1.07	8.42	7.00	7.35	6.00	7.50	......	7.50*	8.00	1.84*	2.50	[illegible]		
														[illegible]	[illegible]
6.34	2.62	2.00	10.96	10.00	8.96	8.00	.33	......	.33	......	2.92	2.47	[illegible]	[illegible]	[illegible]
														[illegible]	[illegible]
5.74	2.60	1.38	9.72	7.00	8.34	6.00	3.95	......	3.95	3.00	1.89*	2.50	[illegible]		
														[illegible]	[illegible]
[illegible] 12	6.20	2.37	11.69	9.00	9.32	8.00	.93	......	.93*	1.00	.92	.82	20.43	[illegible]	[illegible]

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	E. FRANK COE CO., NEW YORK.		
312	Columbian Bone Superphosphate,	B. A. Cranmer, Monroeton,	7.70
279	Columbian Corn Fertilizer,	Heffner & Luckenbill, Friedensburg,	9.42
144	Columbian Potato Fertilizer,	W. W. Wilmarth, Harford,	8.94
195	Empire State Brand No. 1 Complete Fertilizer,	D. E. Brown, East Berlin,	7.75
196	Famous Red Brand Excelsior Guano,	D. E. Brown, East Berlin,	5.85
142	H. G. Ammoniated Bone Phosphate,	W. W. Wilmarth, Harford,	8.25
140	H. G. Potato Fertilizer,	W. W. Wilmarth, Harford,	8.00
590	New England Potato Fertilizer,	H. R. Lowe, Orangeville,	8.90
[illegible]	†XXV Ammoniated Bone Phosphate,	Heffner & Luckenbill, Friedensburg,	11.00
[illegible]		W. W. Wilmarth, Harford,	
589		H. A. Lowe, Orangeville,	
197	XXV Ammoniated Bone Phosphate,	D. E. Brown, East Berlin,	12.34
	HENRY COPE & CO., LINCOLN UNIVERSITY, PA.		
61	Ammoniate Bone Phosphate,	Henry Cope & Co., Oxford,	12.27
55	New Century Bone Phosphate,	Henry Cope & Co., Oxford,	13.80
60	Potato and Corn Phosphate,	Henry Cope & Co., Oxford,	11.43
59	Queen of Elk Valley Phosphate,	Henry Cope & Co., Oxford,	11.22
	JOSIAH COPE & CO., LINCOLN UNIVERSITY, PA.		
50	Ammoniated Bone Phosphate,	Josiah Cope & Co., Oxford,	10.65
47	Potato and Tobacco Phosphate,	Josiah Cope & Co., Oxford,	7.53
45	Pure Bone Phosphate,	Josiah Cope & Co., Oxford,	10.50
49	"Try Me" Bone Phosphate,	Josiah Cope & Co., Oxford,	10.67
48	Wheat and Grass Special,	Josiah Cope & Co., Oxford,	9.13
	E. DARON, DOVER, PA.		
495	Harvest King Phosphate,	E. Daron, Dover,	16.20
	JAMES G. DOWNWARD & CO., COATESVILLE, PA.		
[illegible]	†Ammoniated Bone Phosphate,	Thomas Agnew, Kelton,	7.90
[illegible]		L. A. Geiger, Joanna,	
33	Special Potato Fertilizer,	Thomas Agnew, Kelton,	7.64

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds. Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash in 100 Pounds (Water Soluble). Present as muriate.	Present as sulphate.	Total. Found.	Total. Guaranteed.	Nitrogen in 100 Pounds. Found.	Guaranteed.	Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
6.94	2.93	2.07	**11.94**	......	**9.87**	......	[illegible]	2.47	**2.87**	......	**1.57**	......	26.22	19.00	312
6.52	2.78	2.52	**11.82**	......	**9.30**	......	[illegible]	[illegible]	**3.12**	......	**1.56**	......	26.01	24.00	279
7.46	2.53	2.24	**12.23**	10.00	**9.99**	8.50	[illegible]	[illegible]	**2.93**	2.50	**1.45**	1.24	26.19	26.00	144
6.41	2.58	2.44	**11.43**	......	**8.99**	......	[illegible]	[illegible]	**3.16**	......	**1.36**	......	24.88	26.00	195
8.10	1.73	.79	**10.62**	......	**9.83**	......	......	[illegible]	**5.99**	......	**3.38**	......	36.60	36.00	156
7.46	2.64	2.34	**12.44**	10.50	**10.10**	9.00	.67	1.72	**2.39**	2.25	**1.74***	1.85	26.82	28.00	142
6.50	1.99	1.67	**10.16**	8.50	**8.49**	7.50	......	6.84	**6.84**	6.00	**2.27***	2.47	32.01	32.00	140
5.31	3.40	2.80	**11.51**	......	**8.71**	......	[illegible]	3.01	**3.54**	......	**1.19**	......	24.55	20.00	590
														20.00	283
5.47	3.61	2.91	**11.99**	10.00	**9.08**	8.50	1.97	......	**1.97**	1.50	**1.01**	.82	22.11	21.00	141
														19.00	589
6.36	2.85	2.63	**11.84**	10.00	**8.21**	8.50	1.67	......	**1.67**	1.50	**.84**	.82	21.02	20.00	197
4.13	4.20	1.76	**10.09**	10.00	**8.33**	8.00	2.93	......	**2.93**	2.00	**1.17**	.82	22.18	21.00	61
8.16	3.31	1.94	**13.41**	10.00	**11.47**	9.00	3.69	......	**3.69**	2.00	**1.73**	1.24	29.18	25.00	55
4.11	3.73	1.53	**9.37***	10.00	**7.84***	8.00	[illegible]	......	**5.50**	4.00	**1.36**	1.24	24.90	23.00	60
3.14	2.94	1.67	**7.75***	9.00	**6.08***	8.00	7.64	......	**7.64***	8.00	**1.79**	1.65	26.88	26.00	59
6.84	3.10	1.46	**11.40***	12.00	**9.94***	10.00	2.78	......	**2.78***	3.00	**.98**	.82	23.36	20.00	50
4.81	4.96	1.37	**11.14***	12.00	**9.77***	10.00	7.41	......	**7.41**	7.00	**.93**	.82	27.08	25.00	47
4.86	4.66	4.77	**14.29**	12.00	**9.52**	8.00	2.81	......	**2.81***	3.00	**2.03**	1.65	28.28	26.00	45
8.25	2.17	1.33	**11.75***	12.00	**10.42**	10.00	3.77	......	**3.77***	4.00	**1.79**	1.65	28.02	22.00	49
6.73	2.31	1.03	**10.07**	9.00	**9.04**	8.00	1.26	......	**1.26**	1.00	**.80***	.82	19.81	17.00	48
5.83	2.83	.84	**9.50***	10.00	**8.66**	8.00	5.62	......	**5.62**	5.00	**1.55***	1.65	26.52	22.50	495
														24.00	34
4.69	2.53	2.26	**9.48**	9.00	**7.22***	8.00	2.58	......	**2.58**	2.50	**1.20***	1.24	21.14	22.00	246
5.03	2.54	1.70	**9.27**	9.00	**7.57***	8.00	4.05	......	**4.05**	4.00	**1.45**	1.24	23.67	28.00	33

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	EUREKA FERTILIZER CO., PERRYVILLE, MD.		
233	†Corn and Potato Special,	C. T. Grove, Felton,	12.90
514		Jno. G. Brown, Moyers,	
231	Fish, Rock and Potash,	C. T. Grove, Felton,	12.31
516	Potato and Vegetable Fertilizer,	Jno. G. Brown, Moyers,	11.50
232	Standard Bone Phosphate,	C. T. Grove, Felton,	11.90
515	Wrapper Leaf for Tobacco,	Jno. G. Brown, Moyers,	12.58
	WASHINGTON EWING, LANDENBERG, PA.		
170	Eclipse Raw Bone Superphosphate,	S. K. Chambers & Bro., W. Grove,	9.03
171	Wasteland Potato Phosphate,	S. K. Chambers & Bro., W. Grove,	8.71
	R. K. FAIRLAMB & SONS, BRANDYWINE SUMMIT, PA.		
664	Potato Special Phosphate,	R. K. Fairlamb & Sons, B'ine Sum't,	7.85
	FARMER'S FERTILIZER CO., WESTMINSTER, MD.		
24	Carroll Bone Phospsate,	Cook, Bents & Co.,	8.50
494	XX Bone Phosphate,	Cook, Deardorff & Co., Dillsburg,	9.56
	GRIFFITH & BOYD, BALTIMORE, MD.		
721	†Ammoniated Soluble Bone,	Aaron & Kerr, Kingsville,	9.30
304		A. Gaddis & Co., Uniontown,	
629	Cereal Bone Plant Food,	J. D. Miller, Rockwood,	13.86
558	Farmer's Improved Phosphate,	Callahan Bros., Wellsboro,	11.50
456	†Farmer's Potato Manure,	A. B. Harnish, Mechanicsburg,	9.50
861		Wm. Kipp, Millerstown,	
654		Callahan Bros., Wellsboro,	
810		G. L. Moore, Brownsville,	
572	Farmer's Potato Manure,	E. A. Slagle, Paxinos,	9.21
631	†Fish, Bone and Potash,	J. D. Miller, Rockwood,	12.90
555		Callahan Bros., Wellsboro,	
694		Jno. T. Bingham, Slippery Rock,	
630	†Peerless Fertilizor,	J. D. Miller, Rockwood,	11.22
150		E. A. Slagle, Paxinos,	
511		G. L. Moore, Brownsville,	

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
6.18	3.69	3.04	12.89	12.00	9.85	9.00	2.38	......	2.38	2.00	.68*	.82	22.38	[illegible]	[illegible]
														20.00	514
6.40	4.81	3.24	14.45	9.00	11.21	8.00	.85	......	.85*	1.00	.37*	.41	15.27	16.00	231
6.28	3.77	2.81	12.86	9.00	10.05	8.00	2.68	......	2.68*	4.00	1.11*	1.65	24.34	22.00	516
6.05	4.02	3.37	13.44	12.00	10.07	10.00	2.28	......	2.28	2.00	.98*	1.65	23.84	20.00	232
6.07	3.30	3.01	12.38	10.00	9.37	8.00	3.64	......	3.64*	6.00	1.80*	2.47	27.36	25.00	515
5.65	2.98	2.92	11.55	9.00	8.63	7.00	3.74	......	3.74	2.00	1.42	1.24	25.02	24.00	176
6.00	2.96	2.15	11.11	8.00	8.96	6.00	4.11	......	4.11	3.00	1.26*	1.65	24.81	24.00	171
5.83	2.71	1.85	10.39	10.00	8.54	8.00	10.09	......	10.09	10.00	1.84	1.65	32.64	27.00	664
2.33	5.16	1.34	8.83	8.00	7.49	7.00	3.36	......	3.36	2.00	.53	.41	15.21	15.00	24
5.87	3.38	1.40	10.65	10.00	9.25	8.00	2.89	......	2.89*	3.00	.91	.82	22.18	17.50	494
4.18	3.58	1.90	9.66	......	7.76	......	......	2.80	2.80	......	1.25	......	22.35	22.50	721
														19.00	804
4.86	3.87	1.91	10.64	10.00	8.73	8.00	2.40	......	2.40	2.00	.93	.82	21.44	22.50	629
3.70	3.92	1.94	9.56	9.00	7.62	7.00	2.74	......	2.74	1.50	.87	.82	20.23	18.00	553
														25.00	488
5.32	3.34	1.57	10.23	9.00	8.66	8.00	1.60	6.62	8.22*	9.00	1.18	.82	29.35	26.00	361
														25.00	584
														28.00	310
4.59	3.65	2.23	10.47	9.00	8.24	8.00	9.44	......	9.44	9.00	1.15	.82	28.98	28.00	571
														25.00	631
5.51	2.60	2.01	10.12	8.00	8.11	7.00	2.92	......	2.92*	3.00	1.50	1.44	23.49	22.00	556
														22.00	694
														18.00	[illegible]
[illegible]	5.15	[illegible]	[illegible]	[illegible]	[illegible]	8.00	2.54	......	[illegible]	[illegible]	[illegible]	1.02	[illegible]	[illegible]	[illegible]
														18.00	811

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
556	Spring Crop Grower,	Callahan Bros., Wellsboro,	12.22
487	†Valley Fertilizer,	A. B. Harnish, Mechanicsburg,	12.80
338		J. B. Ewing, Adamsburg,	
695		John T. Bingham, Slippery Rock,	
	A. M. GROVE & CO., MUDDY CREEK FORKS, PA.		
230	Special Potato Fertilizer,	Grove & Uffelman, Brogueville,	10.06
	HANOVER FERTILIZER CO., BALTIMORE, MD.		
442	Hanover Klondyke Special for Potatoes and Tobacco,	H. F. Gump, Everett,	7.12
	S. M. HESS & BRO., PHILADELPHIA.		
236	Special Compound,	Daniel Spangler, Red Lion,	10.72
265	†Special Corn Manure,	A. H. Imboden, Orwigsburg,	12.00
237		Daniel Spangler, Red Lion,	
669		A. B. Mock, Martinsburg,	
	HUBBARD & CO., BALTIMORE, MD.		
405	†Farmer's IXL Superphosphate,	A. Cameron Bobb, Paxinos,	13.60
580		Boettner & Dietz, Danville,	
441	Trucker's 7 per cent. Royal Seal Compound,	Boettner & Dietz, Danville,	9.54
	M. P. HUBBARD & CO., BALTIMORE, MD.		
551	Bermuda 7 per cent. Guano for Early Truck and Potatoes,	R. F. Schwarz, Spragueville,	10.57
23	Excelsior Bone Phosphate,	E. A. Keasey,	16.32
1	†Farmer's Old Economy,	E. A. Keasy,	12.06
634		Kreger & Son, Kingwood,	
	THE JARECKI CHEMICAL CO., SANDUSKY, O.		
375	†Lake Erie Fish Guano,	A. B. Shaffer, Jenners,	12.28
777		Jacob Foust, Windber,	
623	O. K. Fertilizer,	S. S. Mossholder, Brotherton,	11.05
	T. S. KENDERDINE & SONS, NEWTOWN, BUCKS CO. PA.		
189	Bone Phosphate,	Hobensack Bros., Ivyland,	8.58

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Present as muriate.	Present as sulphate.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.			
4.61	2.40	2.55	**9.56**	7.50	**7.01**	6.50	5.02	......	**5.02**	4.50	**2.01**	1.65	26.52	24.00	556
														17.50	487
3.88	4.15	1.96	**9.99**	8.00	**8.03**	7.00	3.28	......	**3.28**	3.00	**.78**	.41	20.95	20.00	338
														20.00	695
5.84	2.30	.89	**9.03**	9.00	**8.14**	8.00	5.33	......	**5.33**	5.00	**.96**	.82	23.44	20.50	230
3.45	3.84	3.93	**11.22**	9.00	**7.29***	8.00	4.25	......	**4.25**	4.00	**1.58***	1.65	25.05	24.00	442
6.30	1.90	.96	**9.16**	9.00	**8.20**	8.00	3.07	1.51	**4.58**	4.00	**.82**	.82	22.51	25.00	236
														23.00	265
7.21	2.45	1.42	**11.08**	9.00	**9.66**	8.00	2.55	......	**2.55**	2.00	**.83**	.82	22.26	24.00	237
														26.00	669
5.51	3.75	2.25	**11.51**	......	**9.26**	8.00	2.22	......	**2.22***	3.00	**1.62***	1.65	21.52	24.00	405
														22.00	580
5.63	1.78	1.29	**8.70**	......	**7.41**	6.00	5.96	......	**5.96**	5.00	**5.10***	5.77	39.36	36.00	581
5.96	2.44	1.45	**9.85**	8.50	**8.40**	7.00	3.72	......	**3.72***	4.00	**4.92***	5.77	37.48	34.50	551
4.52	3.25	.79	**8.56**	......	**7.77**	......	1.87	......	**1.87**	......	**.85**	......	18.85	22.00	23
														22.00	1
7.28	2.48	1.05	**10.81**	10.00	**9.76**	8.00	2.12	......	**2.12**	1.50	**.42**	.41	15.20	16.50	634
														23.00	775
6.48	4.22	2.55	**13.25**	11.00	**10.70**	10.00	......	1.32	**1.32**	1.00	**1.30***	1.65	24.51	25.00	777
4.62	3.19	1.94	**9.75**	7.00	**7.81**	6.00	.85	......	**.85**	.50	**.60**	.41	17.48	14.00	623
7.18	3.55	2.21	**12.94**	11.00	**10.73**	9.00	5.33	......	**5.33**	5.00	**2.52**	2.47	33.00	30.00	18

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	LACKAWANNA FERT. & CHEM. CO., MOOSIC, PA.		
290	†Admiral Dewey,	O. P. Beebe, Montrose,	6.90
594		W. H. Diehl, Northumberland,	
80		J. F. Barber, Mifflinburg,	
765		C. Yeackle, Eckenrode Mills,	
309	†Big Yield,	W. J. Rinewalt, Fairdale,	4.97
128		L. G. Colvin, Craig,	
563		C. V. Gruver, Howard,	
308	†Bone Superphosphate,	W. J. Rinewalt, Fairdale,	9.51
292		Fred. D. Bunnell, Montrose,	
593		W. H. Diehl, Northumberland,	
766		C. Yeackle, Eckenrode Mills,	
293	†Special Manure,	Fred. D. Bunnell, Montrose,	7.88
561		C. V. Gruver, Howard,	
	B. F. LEBERNIGHT, RED LION, PA.		
234	Standard Ammoniated Bone Phosphate,	Lebernight & Ferree, Red Lion,	8.17
	LISTER'S AGRI. CHEM. WORKS, NEWARK, N. J.		
583	Ammoniated Dissolved Bone Phosphate,	H. G. Supplee, Bloomsburg,	10.69
302	Corn and Potato Fertilizer,	J. N. Hersh, New Oxford,	11.57
184	†Harvest Queen Phosphate,	W. E. Baldwin, Embreeville,	
303		J. N. Hersh, New Oxford,	
582	Special Corn and Potato Fertilizer,	H. G. Supplee, Bloomsburg,	8.61
183	†Special Crop Producer,	W. G. Baldwin, Embreeville,	7.69
585		H. G. Supplee, Bloomsburg,	
415	Special Potato,	Stroup Bros., Valencia,	9.20
277	Standard Pure Bone Superphosphate of Lime,	M. S. Greenawalt, Orwigsburg,	10.88
190	†Success Fertilizer,	Hobensack Bros., Ivyland,	12.38
584		H. G. Supplee, Bloomsburg,	
	MAPES FORMULA & PERUVIAN GUANO CO., N. Y.		
623	†Average Soil Complete Manure,	J. S. Fobst, Emaus,	8.53
549		R. F. Schwarz, Spragueville,	
546	Complete Manure for General Use,	R. F. Schwarz, Spragueville,	10.89

For explanation of these tables see p. 713. †Composite sample

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
3.93	2.62	1.29	7.84	7.00	6.55	6.00	1.14	......	1.14	1.00	.86	.82	17.01	23.00	[illegible]
														20.00	[illegible]
														18.00	[illegible]
														18.00	765
3.41	3.44	2.39	9.24	8.00	6.85	6.00	.93	2.84	3.77*	5.00	2.04*	2.06	25.58	32.00	[illegible]
														28.00	[illegible]
														33.00	[illegible]
7.64	2.96	1.02	11.62*	12.00	10.60	10.00	1.78	......	1.78*	2.00	1.57*	1.65	24.56	27.00	[illegible]
														25.00	[illegible]
														25.00	[illegible]
														25.00	[illegible]
6.69	3.35	2.19	12.23	12.00	10.04	10.00	......	6.22	6.22*	6.50	2.31*	2.47	33.39	32.00	[illegible]
														38.00	[illegible]
4.84	2.94	2.17	9.95*	11.50	7.78*	9.25	3.19	......	3.19	1.85	.90	.82	21.16	20.00	[illegible]
5.96	3.83	3.38	13.17	9.00	9.79	8.00	1.86	......	1.86	1.50	2.42	2.06	28.41	28.00	[illegible]
6.79	2.86	2.50	12.15	9.00	9.65	8.00	2.53	.94	3.47	3.00	1.66	1.65	26.88	25.00	[illegible]
7.06	2.86	2.40	12.32	11.00	9.92	9.00	1.73	.50	2.23	2.00	1.22*	1.24	24.09	25.00	[illegible]
														23.50	203
6.54	2.75	3.06	12.35	9.00	9.29	8.00	2.80	.76	3.56	3.00	1.67	1.65	26.79	28.00	[illegible]
5.17	2.84	1.61	9.62	8.00	8.01	7.00	......	1.17	1.17	1.00	.83	.82	19.08	20.00	[illegible]
														20.00	[illegible]
5.92	2.74	2.85	11.51	......	8.66	......	.67	2.28	2.95	......	1.44	......	24.81	25.00	[illegible]
7.29	3.17	3.25	13.71	11.00	10.46	9.00	1.60	.62	2.22	2.00	2.40*	2.47	29.70	21.85	277
6.88	3.47	2.62	12.97	11.00	10.35	9.00	.67	1.46	2.13	2.00	1.38	1.24	25.50	24.00	[illegible]
														25.00	[illegible]
2.56	3.52	2.11	8.19	......	6.08*	7.00	.67	5.53	6.25	6.00	4.25	4.12	36.01	35.00	[illegible]
														37.75	540
1.00	4.92	4.31	10.23	10.00	5.92*	8.00	5.73	......	5.73	4.00	3.63	3.30	32.90	38.75	544

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
545		R. F. Schwarz, Spragueville,	
380	†Corn Manure,	Jno. L. Nissley, Middletown,	10.64
659		Wm. J. Neal, Newtown Square,	
381		Jno. L. Nissley, Middletown,	
268	†Economical Potato Manure,	A. F. Kimmel, Orwigsburg,	9.73
[illegible]		R. F. Schwarz, Spragueville,	
377	General Crop Brand,	Jno. L. Nissley, Middletown,	9.77
660	General Crop Brand,	Wm. J. Neal, Newtown Square,	12.25
379	Grain Brand,	Jno. L. Nissley, Middletown,	10.75
382	Potato Manure,	Jno. L. Nissley, Middletown,	7.69
547	Potato Manure,	R. F. Schwarz, Spragueville,	9.84
378	Vegetable Manure or Complete Manure,	Jno. L. Nissley, Middletown,	8.17
	McCALMONT & CO., BELLEFONTE, PA.		
564	$25 Champion Ammoniated Bone Superphosphate,	McCalmont & Co., Bellefonte,	12.40
	WM. C. NEWPORT CO., WILLOW GROVE, PA.		
165	All Crop Phosphate,	J. Watson Craft, Ambler,	8.90
167	†Gilt Edge Potato Manure,	J. Watson Kraft, Ambler,	10.83
252		Geo. K. Linderman, Birdsboro,	
254	Grain and Grass Special,	Geo. K. Linderman, Birdsboro,	8.90
818	No. 1 for Potatoes, Corn and Truck,	New Hope, Pa.,	10.57
168	Rectified Phosphate,	J. Watson Kraft, Ambler,	10.91
185	10 Per Cent. Potash Phosphate,	Lewis Hagaman, Rushland,	3.80
	G. OBER & SONS CO., BALTIMORE, MD.		
100	Farmer's Mixture,	W. M. Atkinson, McVeytown,	5.60
	PATAPSCO GUANO CO., BALTIMORE, MD.		
227		J. W. Gemmil, Brogueville,	
303		B. H. Brown, Tunkhannock,	
78	†Coon Brand Guano,	Addison Baker, Vicksburg,	
384		Jos. Burkholder, Hummelstown,	9.65
586		W. F. Slagle, Bloomsburg,	
638		C. B. Moore, New Lexington,	
973	Corn and Tomato Fertilizer,	Jacob Fritz, New Bloomfield,	9.95

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
														36.75	54
1.53	5.29	4.29	11.11	10.00	6.82*	8.00	6.59	......	6.59	6.00	2.60	2.47	30.7[illegible]	[illegible]	38[illegible]
														35.[illegible]	659
														35.[illegible]	341
1.14	2.92	2.91	6.97	6.00	4.06	4.00	.93	8.65	9.58	8.00	3.39	3.30	[illegible]1.71	[illegible]	[illegible]
														37.75	518
3.32	3.52	2.93	9.77*	10.00	6.84*	8.00	2.80	......	2.80	2.00	1.85	1.65	[illegible]	[illegible]	377
2.49	4.62	3.42	10.46	......	7.04*	8.00	2.88	......	2.88	2.00	1.80	1.65	[illegible]	[illegible]	[illegible]
4.90	4.03	1.39	10.32	......	8.93	8.00	4.23	......	4.23	4.00	1.02	.82	23.44	[illegible]	37[illegible]
3.98	3.00	3.05	10.03	10.00	6.98*	8.00	2.27	5.14	7.41	6.00	3.60*	3.71	[illegible]6.20	[illegible]	[illegible]
3.5[illegible]	4.50	2.69	10.69	10.00	8.00	8.00	1.07	6.77	7.84	6.00	3.64*	3.71	[illegible]	40.75	[illegible]47
2.05	3.87	3.06	8.98	8.00	5.92*	6.00	1.87	5.63	7.50	6.00	5.76	4.94	43.28	42.00	37[illegible]
7.31	2.43	1.70	11.44*	12.00	9.74*	10.00	2.27	......	2.27	2.00	1.87	1.65	26.02	24.00	564
4.38	2.67	3.42	10.47	8.00	7.05	6.00	1.13	......	1.13	1.00	1.45*	1.65	20.92	[illegible]	1[illegible]
														[illegible]	167
5.29	2.06	1.36	9.31	9.00	7.95	7.00	7.07	2.22	9.29*	10.00	1.54*	1.85	[illegible]		
														[illegible]	2[illegible]2
2.26	4.07	1.21	7.48*	8.00	6.27	6.00	3.39	......	3.39	2.00	1.15	.82	[illegible]	19.00	254
4.18	4.30	2.00	10.48	10.00	8.48	8.00	2.37	......	2.37*	3.00	1.74	1.65	24.16	....	81[illegible]
5.18	2.20	3.27	10.65	9.00	7.38	7.00	2.67	2.23	4.90*	5.00	3.10*	3.30	[illegible]	[illegible]	16[illegible]
1.94	1.58	6.15	9.67	......	3.52	......	10.25	......	10.25	......	1.77	......	[illegible]	30.00	185
2.56	6.70	6.15	15.21	11.00	9.06	9.00	2.46	......	2.46	2.00	1.31	.82	24.90	20.00	100
														20.00	227
														20.00	[illegible]
														20.00	78
6.56	2.92	1.19	10.67	10.00	9.48	9.00	3.02	......	3.02	3.00	.82	.82	22.10	20.00	384
														20.00	586
														21.00	6[illegible]8
7.59	2.18	1.01	10.78*	11.00	9.77	9.00	2.01	......	2.01	2.00	1.26	1.24	23.22	21.00	37[illegible]

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
204	†Sea Gull Guano,	J. M. Hersh, New Oxford,	8.53
219		Jonathan Geasey, Dallastown,	
376	Tobacco and Potato Fertilizer,	Hershey & Rupley, Marysville,	9.62
	PA. AMM. & FERT. WKS., LTD, HARRISBURG, PA.		
483	Capitol Bone Superphosphate,	J. H. Urich, Mechanicsburg,	7.57
482	Dauphin Brand Fertilizer,	J. H. Urich, Mechanicsburg,	12.80
383	Special Brand Fertilizer,	M. D. Ebersole, Middletown,	8.09
	PITTSBURG PROVISION CO., PITTSBURG, PA.		
807	[illegible] Potato Fertilizer,	W. M. Davis, Greensboro,	4.59
[illegible]		Laidly & Randolph, Rice's Landing,	
	R. H. POLLOCK, BALTIMORE, MD.		
235	†Special Potato and Tobacco Fertilizer,	Elias Gable, Red Lion,	8.45
101		H. M. Owens & Co., Lewistown,	
343		Jno. W. Dubbs, Bellefonte,	
[illegible]		J. A. C. Rider, Tyrone,	
341	†Superior Corn and Tomato Fertilizer,	Jno. W. Dubbs, Bellefonte,	
65		—— ———, Oxford,	
451		J. A. C. Rider, Tyrone,	
	PUGH & LYONS, OXFORD, PA.		
42	Bone Phosphate,	S. R. Dickey & Co., Oxford,	7.53
	RASIN-MONUMENTAL CO., BALTIMORE, MD.		
446	Ammoniated Superphosphate,	Cleaver & Gaily, Bedford,	16.10
224	†IXL Fertilizer,	G. B. Murphy, Keys,	14.59
73		W. H. Harter, Hartleton,	
447		Cleaver & Gaily, Bedford,	
72	Monumental Potato Manure,	Wilson & Me'nhall, Toughkenamon,	14.21
145	Wm. Penn Crop Grower,	Wilson & Me'nhall, Toughkenamon,	15.67
	READING CHEMICAL CO., READING, PA.		
202	Star Fertilizer,	Wm. Ohlinger, Shoemakersville,	9.90
	THE RUSSELL AGRI. CHEM. CO., NEWARK, N. J.		
658	Special Potato Fertilizer,	Brinton & Worth, West Chester,	12.63
657	10 Per Cent. Potato Fertilizer,	Brinton & Worth, West Chester,	11.23

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds: Soluble in water.	Reverted.	Insoluble.	Total: Found.	Total: Guaranteed.	Available: Found.	Available: Guaranteed.	Potash in 100 Pounds (Water Soluble): Present as muriate.	Present as sulphate.	Total: Found.	Total: Guaranteed.	Nitrogen in 100 Pounds: Found.	Guaranteed.	Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
5.79	2.76	1.08	9.63	9.00	8.55	8.00	1.24	......	1.24	1.00	.88	.82	19.59	21.00	204
														20.00	219
5.40	2.86	1.72	9.98	9.00	8.26	8.00	4.16	......	4.16	4.00	1.73	1.65	25.76	24.00	376
5.29	5.17	4.05	14.51	11.50	10.46	10.00	2.66	......	2.66	2.00	2.56	2.47	30.76	28.00	483
4.71	5.76	1.81	12.28	11.50	10.47	10.00	2.46	......	2.46	2.00	1.19*	1.24	24.28	23.00	482
4.54	4.30	2.60	11.44	9.50	8.84	8.00	2.13	......	2.13	2.00	1.09	.82	22.17	20.00	383
.73	4.56	5.34	10.63*	11.00	5.29*	9.00	1.47	3.47	4.94	3.00	1.64*	1.65	24.80	26.00	807
														24.00	809
4.96	3.41	1.91	10.28	9.00	8.37	8.00	4.27	......	4.27	4.00	1.52*	1.65	25.08	25.00	235
														27.00	101
														32.00	343
														30.00	452
5.54	2.86	1.09	9.49	9.00	8.40	8.00	2.29	......	2.29*	4.00	.89*	1.65	20.48	27.00	341
														....	65
														24.00	451
3.16	3.95	7.83	14.94	11.00	7.11	6.00	2.92	......	2.92*	5.00	1.27*	1.65	23.98	26.50	42
5.59	3.55	.50	9.64	9.00	9.14	8.00	1.10	......	1.10	1.00	.86	.82	19.59	22.00	446
7.21	2.20	.73	10.14	10.00	9.41	9.00	3.41	......	3.41	3.00	.92	.82	22.70	20.00	224
														20.00	73
														24.00	447
5.05	2.33	.50	7.88	7.00	7.38	6.00	3.16	......	3.16*	4.00	.93	.82	20.11	22.00	72
6.66	2.73	.37	9.76	9.00	9.39	8.00	1.25	......	1.25	1.00	.82	.82	19.87	20.00	145
1.35	5.19	4.88	11.42	6.00	6.54	5.00	1.08	......	1.08	.50	.33*	.82	12.72	14.00	262
4.59	4.61	1.80	11.00	......	9.20	8.00	2.54	......	2.54*	3.00	1.38*	1.65	23.73	26.00	658
4.36	4.26	2.44	11.06	......	8.62	8.00	......	9.60	9.60*	10.00	1.43*	1.65	32.49	36.00	657

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	RUSSELL & WHITEHEAD, NEWARK, N. J.		
656	[illegible],	Brinton & Worth, West Chester,	5.85
	SCHALL-SHELDON FERT. CO., ERIE, PA.		
[illegible]	[illegible],	Ephraim Adams, Wick,	7.97
[illegible]	Farmer's Favorite,	J. M. Roberts, Slippery Rock,	8.62
[illegible]	[illegible],	J. T. Lock, Grove City,	8.80
[illegible]		J. M. Harshberger & Son, J'nstown,	
	THE SCIENTIFIC FERT. CO., PITTSBURG, PA.		
[illegible]	Corn and Grain Fertilizer,	J. E. Cramer, Markleton,	9.09
[illegible]	[illegible] Fertilizer,	A. G. Lembower, Markleton,	9.90
	THE SCOTT FERTILIZER CO., ELKTON, MD.		
[illegible]	Corn and Oats Grower,	D. R. Stein, Orwigsburg,	11.06
[illegible]	Elk Head Superphosphate,	D. R. Stein, Orwigsburg,	8.50
[illegible]	†Petato, Truck and Tobacco Grower,	D. R. Stein, Orwigsburg,	9.00
[illegible]		Jas. E. Eastman, Orwell,	
[illegible]	Sure Growth Compound,	W. H. Diehl, Northumberland,	7.22
[illegible]	Sure Growth Superphosphate,	D. R. Stein, Orwigsburg,	9.00
	SHENANDOAH FERT'ZER CO., SHENANDOAH, PA.		
[illegible]	Farmer's Choice Brand,	A. Cameron Bobb, Paxinos,	9.87
[illegible]	†Gold Eagle,	J. A. Romberger, Elizabethville,	11.46
[illegible]		A. Cameron Bobb, Paxinos,	
[illegible]		Steininger Bros., Middleburg,	
[illegible]		Jno. H. Reid, De Turksville,	
[illegible]		Wm. L. Fehr, Rock,	
[illegible]	†N. & S. Complete Fertilizer,	Steininger Bros., Middleburg,	10.05
[illegible]		J. F. Barber, Millintown,	
[illegible]		A. Cameron Bobb, Paxinos,	
508		Wm. L. Fehr, Rock,	
308	†Ringtown Clover,	A. Cameron Bobb, Paxinos,	11.18
505		Jno. H. Reid, De Turksville,	
	M. L. SHOEMAKER & CO., PHILADELPHIA, PA.		
650	Swift-Sure Guano for Tomatoes, Truck and Corn,	M. H. Matlack & Co., W. Chester,	11.95

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.				
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.	Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
3.34	5.86	1.74	10.94	.....	9.20	8.00	1.84	......	1.84*	2.00	1.08	.82	21.69	23.00	656
2.17	4.58	2.13	8.88	8.00	6.75*	7.00	1.66	......	1.66	1.00	1.10	.95	18.88	20.00	428
5.33	3.55	2.26	11.14	9.00	8.88	8.00	1.32	......	1.32*	2.00	1.16	1.15	21.49	22.00	430
5.85	4.16	2.85	10.86	9.00	8.01	8.00	.80	2.23	3.03*	4.00	1.16	.82	22.81	24.00 25.00	696 743
5.14	2.55	3.77	11.46	9.00	7.69*	8.00	2.50	......	2.50	2.00	2.24	1.65	26.34	18.00	789
3.10	2.72	3.07	13.89	10.00	10.82	9.00	4.00	......	4.00	4.00	1.36*	1.65	27.82	19.00	790
8.38	3.73	1.04	13.15	9.00	12.11	8.00	1.97	......	1.97*	2.00	.66	.41	23.47	18.00	274
5.37	5.01	5.58	15.96	10.00	10.38	9.00	.53	.70	1.23	1.00	1.00	.82	24.15	19.00	276
4.99	3.20	3.38	11.57	9.00	8.19	7.00	5.38	......	5.38	5.00	1.78	1.65	27.88	23.00	273 328
6.13	2.64	1.59	10.36	......	8.77	......	......	9.20	9.20	......	3.31	......	30.07	35.00	596
8.74	3.23	2.45	14.42	12.00	11.97	10.00	2.65	......	2.65	2.00	2.25	1.65	30.87	23.00	275
7.14	1.96	1.01	10.11	......	9.10	......	2.20	......	2.20	......	.90	......	21.27	22.00	399
3.15	3.87	2.46	9.48	......	7.02*	9.00	1.75	......	1.75*	1.85	.86	.82	18.62	15.00 17.00 19.00 16.00 20.00	387 400 89 504 509
2.96	3.78	2.11	8.85	......	6.74*	8.00	1.39	......	1.39*	2.85	.37*	.41	12.33	18.00 18.00 16.00 17.00	88 79 401 508
2.56	3.71	1.74	8.01	......	6.27*	16.00	.67	1.84	2.51*	5.70	.88*	1.65	18.63	20.00 20.00	398 505
4.59	3.86	4.65	13.10	......	8.45	8.00	5.42	......	5.42	5.00	2.01	1.65	29.50	27.00	659

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds
651	Swift-Sure Superphosphate for General Use,	M. H. Matlack & Co., W. Chester,	10.79
524	†Swift-Sure Superphosphate for Potatoes,	J. S. Fobst, Emaus,	9.43
653		M. H. Matlack & Co., W. Chester,	
652	$23 Phosphate,	M. H. Matlack & Co., W. Chester,	8.36
	CHAS. A. SICKLER & BRO., WILKES-BARRE, PA.		
127	†Empire Phosphate,	W. D. Spencer, Waverly,	4.57
130		G. H. Hinckley, Nicholson,	
122	†Special Manure for Potatoes and Vegetables,	E. J. Hull, Oliphant,	6.24
126		W. D. Spencer, Waverly,	
123	†Vegetable and Vine Fertilizer,	E. J. Hull, Oliphant,	5.34
131		G. H. Hinckley, Nicholson,	
	E. A. SLAGLE, PAXINOS, PA.		
407	Plant Food,	E. A. Slagle, Paxinos,	9.55
	H. H. SMYSER, YORK, PA.		
498	Chicago Bone and Potash,	H. H. Smyser, York,	9.11
499	Chicago Bone and Tankage,	H. H. Smyser, York,	10.79
	SOUTHERN FERTILIZING CO., YORK, PA.		
502	Ammoniated Dissolved Bone,	Wagner & Ernst, York,	11.61
223	†Farmer's Choice Brand,	G. B. Murphy, Keys,	9.59
271		A. F. Kimmel, Orwigsburg,	
193		Geo. Nell,	
560		J. M. Getz., Jr., Lock Haven,	
402	General Crop Grower,	A. Cameron Bobb, Paxinos,	8.93
503	†Special Potato Grower,	Wagner & Ernst, York,	10.40
270		A. F. Kimmel, Orwigsburg,	
559		J. M. Getz, Jr., Lock Haven,	
624		Simon Fontz, Berlin,	
	SWIFT & CO., CHICAGO, ILL.		
423	Complete Fertilizer,	Craig Hardware Co., Mars,	4.47
424	Superphosphate,	Craig Hardware Co., Mars,	4.61

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
7.31	3.72	4.45	15.48	14.00	11.03	9.00	5.05	......	5.05	4.00	2.62	2.47	34.48	32.00	651
6.91	2.77	5.04	14.72	11.00	9.68	8.00	6.39	......	6.39*	6.50	2.66	2.47	34.78	33.00	524
														32.00	653
3.16	3.56	7.76	14.48	8.00	6.72	6.00	2.17	......	2.17	1.00	1.33	.82	23.18	23.00	652
2.72	1.89	2.34	6.95*	9.00	4.61*	8.00	3.19	......	3.19	2.00	1.46*	1.65	19.65	26.00	127
														....	130
2.40	2.25	3.99	8.64*	9.00	4.65*	8.00	6.96	......	6.96	6.50	1.88*	3.30	25.30	31.00	122
														36.00	126
2.11	2.18	4.28	8.57*	12.00	4.29*	10.00	5.80	......	5.80	4.00	1.74*	2.47	23.97	29.00	123
														....	131
5.27	3.37	.88	9.52	......	8.64	8.00	2.44	......	2.44	2.00	.62	.41	19.56	18.00	407
8.25	1.19	.50	9.94	......	9.44	8.00	4.12	......	4.12	4.00	.86*	1.03	23.29	22.00	498
[illegible].87	1.78	1.03	11.68	......	10.65	8.00	1.26	......	1.26	1.00	1.01*	1.03	22.58	19.00	499
7.76	2.62	1.52	11.90	11.20	10.38	10.00	2.72	......	2.72	2.50	1.60*	1.65	26.19	24.00	502
6.49	2.22	.91	9.62*	10.00	8.71*	9.00	2.32	......	2.32	2.00	.82	.82	20.43	19.00	223
														22.00	271
														19.00	193
														22.00	560
5.24	3.62	.73	9.59	9.00	8.86	8.00	2.53	......	2.53	2.00	.51	.41	19.47	18.00	402
6.02	2.55	1.15	9.72	9.50	8.57	8.00	3.98	......	3.98*	4.00	1.30	1.24	23.98	24.00	503
														25.00	270
														27.00	559
														22.50	624
5.69	4.45	2.79	12.93	11.00	10.14	8.00	.97	......	.97*	1.00	.99*	1.03	22.21	22.00	423
6.29	3.34	4.65	14.28	12.00	9.63	8.00	1.95	......	1.95*	2.00	2.37	1.65	28.83	25.00	424

*Constituent falls below guarantee.

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COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	I. P. THOMAS & SONS CO., PHILA., PA.		
110	†Improved Superphosphate,	Jno. M. Yoder, Bellville,	8.70
456		Sudeker & Mitchell, Troy,	
109	†Normal Bone Phosphate,	Jno. M. Yoder, Bellville,	10.61
332		E. D. Chaffer, Orwell,	
137	Potato Manure,	E. D. Snyder, Brooklyn,	13.12
	JAMES THOMAS, WILLIAMSPORT, PA.		
478	H. G. Bone Superphosphate,	Elwin Allen & Co., Canton,	10.76
461	†H. G. Potato and Tobacco Manure,	Compton & Lilley, Troy,	9.81
106		Watt Bros, Bellville,	
738		Parker Bros, Ebensburg,	
460	†Klondyke,	Compton & Lilley, Troy,	9.25
105		Watt Bros., Bellville,	
739		Barker Bros., Ebensburg,	
459	Special Compound for Wheat, Oats, Corn and Grass,	Compton & Lilley, Troy,	13.14
108	†Standard Bone Phosphate,	Watt Bros., Bellville,	8.55
740		Barker Bros., Ebensburg,	
479	Standard Phosphate,	Elwin Allen & Co., Canton,	7.90
	TUSCARORA FERTILIZER CO., PORT ROYAL, PA.		
103	†Ammoniated Tuscarora Phosphate,	H. M. Owens & Co., Lewistown,	12.31
477		Ogden & Allen, Canton,	
104	†Big Four,	M. P. Yoder, Bellville,	17.58
76		Geo. W. Young, Mifflinburg,	
476		Ogden & Allen, Canton,	
	VERMONT CHEM. FERT. CO., VIRGINIUS, VT.		
129‡	Coral Lawn and Garden Dressing,	Hunt & Connell, Waverly,	1.15
	WALKER, STRATMAN & CO., PITTSBURG, PA.		
610	†Big Bonanza,	M. A. Brubaker, Hooversville,	7.32
393		R. McCoy, Slippery Rock,	
411		Hunter & Sons, Crawford's Corners,	
763		C. Yeackle, Eckenrode's Mills,	
767	Meat, Blood and Bone with Potash,	C. Yeackle, Eckenrode's Mills,	8.45

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
7.23	4.03	2.41	**13.67**	12.00	**11.26**	10.00	1.10	......	**1.10**	1.00	**.61***	.82	16.32	22.00	110
														25.00	436
6.00	2.85	1.86	**10.71**	9.50	**8.85**	8.50	1.84	......	**1.84**	1.50	**1.17**	1.03	21.87	24.00	109
														......	332
5.96	3.30	2.11	**11.37**	10.50	**9.26**	9.00	6.33	......	**6.33**	6.00	**2.28**	1.65	31.42	......	137
6.55	2.19	1.68	**10.42***	14.00	**8.74***	9.00	2.53	......	**2.53**	2.50	**2.05***	2.06	25.90	23.00	478
														30.00	461
6.91	1.81	1.17	**9.89***	12.00	**8.72***	9.00	5.79	......	**5.79***	6.00	**1.98***	2.06	28.80	31.00	106
														32.00	738
														22.00	460
6.64	3.02	1.43	**11.09**	10.00	**9.66**	9.00	3.07	......	**3.07**	3.00	**.87**	.82	22.69	22.40	105
														23.00	739
7.98	3.05	1.11	**12.14**	11.00	**11.03**	9.00	2.23	......	**2.23***	3.00	**1.14**	1.03	24.54	24.00	459
6.78	2.38	1.01	**10.17**	10.00	**9.16**	8.00	2.25	......	**2.25**	2.00	**.84**	.50	21.14	21.00	108
														20.00	740
4.84	3.57	.92	**9.33***	10.00	**8.41**	8.00	2.62	......	**2.62**	2.00	**.59**	.50	19.50	18.00	479
2.12	4.86	3.46	**10.44**	8.00	**6.98***	7.00	1.14	......	**1.14**	1.00	**.69***	.82	17.74	20.00	103
														18.00	477
														25.00	104
2.12	6.07	2.67	**10.86**	8.00	**8.19**	7.00	2.77	......	**2.77***	4.00	**1.41***	1.65	22.98	30.0	76
														30.00	476
......	.66	.67	**1.33**	......	**.66**	......	.65	......	**.65**	......	**.70**	......	8.79	30.00	‡129
														22.00	610
														23.00	693
73	2.48	4.22	**12.43**	10.00	**8.21***	9.00	4.20	......	**4.20**	4.00	**1.75**	1.65	27.02	24.00	411
														25.00	768
4.54	2.74	4.10	**11.38**	10.00	**7.28***	8.00	1.47	6.15	**7.62***	8.00	**3.64**	3.30	37.68	40.00	767

*Constituent falls below guarantee.
‡Not included in summary.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
138	Potato Special Fertilizer, ...	W. H. Devall, S. Gibson, ...	5.80
	W. E. WHANN, WILLIAM PENN, PA.		
192	Chester Valley Available Ammoniated Superphosphate,	J. Huston, Hatboro, ...	7.91
191	Chester Valley Special Potato and Truck Fertilizer, ...	J. Huston, Hatboro, ...	9.08
	THE ROBT. A. WOOLRIDGE CO., BALTIMORE, MD.		
68	Champion Giant Phosphate, ...	Franklin G. Evans, Kelton, ...	12.15
285		D. B. Stahler, Friedensburg, ...	
225	Triumph Pure Bone, ...	G. B. Murphy, Keys, ...	9.91
36	†Triumph Pure Bone Phosphate, ...	Franklin G. Evans, Kelton, ...	9.36
284		D. B. Stahler, Friedensburg, ...	
	YORK CHEMICAL WORKS, YORK, PA.		
13	Dempwolf's New York Phosphate, ...	A. K. Straley, Hall, ...	12.50
10	Dempwolf's Potato and Tobacco Fertilizer, ...	A. K. Straley, Hall, ...	12.65
	HENRY S. ZOOK, ELVERSON, PA.		
251	Pride of Chester Corn, Oats and Wheat Phosphate, ...	Henry S. Zook, White Bear, ...	11.23
243	Pride of Chester No. 5 Corn, Oats and Wheat Phosphate, ...	Henry S. Zook, Joanna, ...	10.90

For explanation of these tables see p. 713. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
4.91	2.62	5.49	**13.02**	10.00	**7.53***	8.00	.80	5.47	**6.27**	6.00	**2.73**	2.47	33.64	....	138
3.72	4.25	1.59	**9.56**	......	**7.97**	7.00	3.07	......	**3.07**	3.00	**1.11**	1.00	21.54	....	192
4.30	2.77	.90	**7.97***	10.00	**7.07**	7.00	7.19	......	**7.19**	7.00	**2.11***	2.47	28.38	....	191
7.36	2.47	1.04	**10.87**	......	**9.83**	9.00	2.42	......	**2.42**	2.00	**.83**	.82	22.09	21.00	35
														18.00	285
5.79	2.11	1.15	**9.05**	......	**7.90***	8.00	4.34	......	**4.34**	4.00	**1.22***	1.24	23.23	21.00	225
6.11	2.04	1.15	**9.30**	......	**8.15**	8.00	4.31	......	**4.31**	4.00	**1.19***	1.24	23.49	24.00	36
														22.00	284
2.69	6.46	2.07	**11.22**	10.00	**9.15**	8.00	2.31	......	**2.31**	2.00	**.74**	.41	20.83	[illegible]	12
5.04	3.64	.90	**9.58**	9.00	**8.68**	7.00	1.60	3.75	**5.35***	7.00	**1.79***	2.47	27.88	27.00	[illegible]
8.16	4.63	1.06	**13.85**	......	**12.79**	10.00	2.58	......	**2.58**	2.00	**.40***	.41	17.64	[illegible]	[illegible]
7.56	5.16	1.15	**13.87**	......	**12.72**	10.00	2.28	......	**2.28**	2.00	**.46**	.41	17.32	18.00	[illegible]

*Constituent falls below guarantee.

ROCK AND POTASH

Furnishing Phosphoric

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds
	THE AMERICAN AGRI. CHEMICAL CO., N. Y.		
	BRADLEY BRANCH, BOSTON, MASS.		
732	†Bradley's Alkaline Bone with Potash,	C. Marshall, Luthersburg,	11.77
322		Daniel Henley, Wysox,	
748		A. F. Stutzman, Johnstown,	
	CANTON CHEMICAL BRANCH, BALTIMORE, MD.		
490	†Canton Chemical Soluble Bone and Potash,	S. M. Bailey & Bro., Dillsburg,	11.38
86		W. B. Winey, Middleburg,	
543		Morris Nauman, Stroudsburg,	
797		King Bros., Uniontown,	
120	Canton Cremical Soluble Bone and Potash,	J. W. Hostettler, Walnut,	9.63
	CROCKER BRANCH, BUFFALO, N. Y.		
720	†Crocker's Dissolved Bone and Potash,	W. R. Henderson, Henderson,	9.20
690		J. T. Lock, Grove City,	
762		T. J. Jacobs, Somerfield,	
	DETRICK BRANCH, BALTIMORE, MD.		
63	Detrick's Soluble Bone and Potash,	—— ——, Oxford,	10.66
115	Detrick's Soluble Bone Phosphate with Potash,	James McCauley, Mifflintown,	9.02
77	†Detrick's Soluble Bone Phosphate and Potash,	Daniel Miller, Mifflinburg,	11.91
611		Newton Gouder, Jenners,	
	GREAT EASTERN BRANCH, RUTLAND, VT.		
471	†Great Eastern Soluble Bone and Potash,	L. T. Weller, East Troy,	12.45
316		M. A. Cranmer, Monroeton,	
702		Atwell & Perry, Big Bend,	
772		C. K. Ankeny, Jenners,	
	LAZARETTO BRANCH, BALTIMORE, MD.		
172	†Lazaretto Dissolved Bone and Potash,	S. K. Chambers & Bros., W. Grove,	10.00
211		Z. H. Cashman, New Oxford,	
	MARYLAND BRANCH, BALTIMORE, MD.		
217	Maryland Bone Superphosphate,	H. H. Loose, Menges Mills,	10.14

For explanation of these tables see p. 713. †Composite sample.

FERTILIZERS.

Acid and Potash.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.				Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
			Total.		Available.				Total.				
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.			
												22.00	732
6.09	4.67	1.34	**12.10**	11.00	**10.76**	10.00	2.15	....	**2.15**	2.00	14.28	16.00	322
												17.00	748
												15.50	490
												15.00	86
5.33	4.99	.89	**11.21**	11.00	**10.32**	10.00	2.17	....	**2.17**	2.00	13.74	15.00	543
												18.00	707
5.04	4.93	1.18	**11.15**	11.00	**9.97***	10.00	2.25	....	**2.25**	2.00	13.72	14.00	120
												21.00	720
5.31	5.59	1.76	**12.66**	11.00	**10.90**	10.00	1.60	.58	**2.18**	2.00	14.56	20.00	699
												17.00	792
4.50	5.35	1.66	**11.51**	11.00	**9.85***	10.00	2.32	....	**2.32**	2.00	13.81	......	63
5.92	5.22	.73	**11.87**	11.00	**11.14**	10.00	2.11	....	**2.11**	2.00	14.19	15.00	115
												15.00	77
8.61	2.36	.85	**11.82**	11.00	**10.97**	10.00	2.19	....	**2.19**	2.00	14.56	16.00	614
												14.60	471
												......	316
6.98	3.43	1.14	**11.55**	11.00	**10.41**	10.00	2.86	....	**2.86**	2.00	14.80	17.50	702
												17.00	772
5.63	4.45	1.21	**11.29**	11.00	**10.08**	10.00	2.10	....	**2.10**	2.00	13.72	14.50	172
												14.00	211
6.76	3.89	.91	**11.56**	11.00	**10.65**	10.00	2.10	....	**2.10**	2.00	14.07	15.00	217

*Constituent falls below guarantee.

ROCK AND POTASH

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
667	Maryland Bone Superphosphate,	Skyles, Miller & Co., Martinsburg,	13.52
218	Maryland Linden Superphosphate,	H. H. Loose, Menges Mills,	11.07
	MILSOM BRANCH, EAST BUFFALO, N. Y.		
259	†Milsom's Dissolved Bone and Potash,	Jacob Hollenbaugh, Hamburg,	11.00
729		J. H. Eddinger, Luthersburg,	
	PACIFIC GUANO BRANCH, NEW YORK.		
281	Pacific Dissolved Bone and Potash,	A. D. Super, Friedensburg,	10.30
	PACKER'S UNION BRANCH, RUTLAND, VT.		
467	†Packer's Union Banner Wheat Grower,	Fred. Varney, East Troy,	15.84
470		John R. Jones, East Troy,	
517		P. H. Fehr, Rock,	
18		J. W. Gladfelter, Rossville,	
567		J. P. Schneider, Huntingdon,	
612		N. D. Bowman, Stanton's Mills,	
626		R. C. Heffley, Berlin,	
469	Packer's Union H. G. Wheat, Oats and Clover,	Fred. Varney, East Troy,	13.12
	QUINNIPIAC BRANCH, NEW YORK.		
8	Quinnipiac Dissolved Bone and Potash,	Paxt'n Fl. & Fd. Co., Bowmansdale,	11.73
	READ BRANCH, NEW YORK, N. Y.		
529	Read's Alkaline Bone and Potash Fertilizer,	W. M. Gehman, Macungie,	8.75
	REESE BRANCH, BALTIMORE, MD.		
15	Reese's Wheat Special,	M. H. Spangler, Rossville,	12.00
	SHARPLESS & CARPENTER BRANCH, PHILA., PA.		
176	†Sharpless & Carpenter's Soluble Bone and Potash,	E. A. & J. L. Pennock, Chathom,	9.50
511		A. Kirschner, Rock,	
	STANDARD BRANCH, NEW YORK.		
496	Standard Bone and Potash,	E. A. Keasey, Dover,	11.76
	SUSQUEHANNA BRANCH, BALTIMORE, MD.		
3	†Susquehanna Alkaline Bone Phosphate,	J. H. Myers, Bowmansdale,	11.23
52		Geo. B. Passmore & Sons, Oxford,	
4	Susquehanna H. G. Bone and Potash,	J. H. Myers, Bowmansdale,	12.40
117	Susquehanna H. G. Bone and Potash,	W. V. Shirk, Oakland Mills,	10.74

For explanation of these tables see p. 713. †Composite sample.

FERTILIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.				Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
			Total.		Available.				Total.				
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.			
5.87	4.71	.84	**11.42**	11.00	**10.58**	10.00	2.12	....	**2.12**	2.00	13.89	15.00	667
7.58	4.43	.85	**12.86**	12.00	**12.01**	11.00	2.06	....	**2.06**	2.00	14.91	17.00	218
4.57	5.53	1.67	**11.77**	11.00	**10.10**	10.00	2.09	....	**2.09**	2.00	13.76	13.00	259
												20.00	729
5.40	4.93	2.20	**12.53**	11.00	**10.33**	10.00	1.68	....	**1.68***	2.00	13.80	17.00	281
6.95	3.71	.71	**11.37**	11.00	**10.66**	10.00	2.15	....	**2.15**	2.00	14.07	......	467
												18.00	470
												15.00	517
												16.00	18
												16.00	567
												20.00	612
												17.00	626
7.47	4.96	.96	**13.39**	....	**12.43**	....	1.90	....	**1.90**	....	15.07	......	469
8.16	2.60	.36	**11.12**	11.00	**10.76**	10.00	2.03	....	**2.03**	2.00	14.05	16.00	8
5.33	4.73	2.63	**12.69**	11.00	**10.06**	10.00	2.14	....	**2.14**	2.00	14.24	18.00	529
8.96	3.13	.46	**12.55**	11.00	**12.09**	10.00	1.70	....	**1.70***	2.00	14.65	15.00	15
5.12	4.55	1.86	**11.53**	11.00	**9.67***	10.00	1.92	....	**1.92***	2.00	13.46	15.00	176
												18.00	511
7.76	2.56	.43	**10.75***	11.00	**10.32**	10.00	2.06	....	**2.06**	2.00	13.77	16.00	496
4.27	5.17	1.60	**11.04**	11.00	**9.44***	10.00	2.20	....	**2.20**	2.00	13.41	17.00	3
												15.00	52
7.41	4.64	1.43	**13.48**	13.00	**12.05**	12.00	4.31	....	**4.31***	5.00	17.44	20.00	4
7.90	4.04	1.77	**13.71**	13.00	**11.94***	12.00	4.21	....	**4.21***	5.00	17.44	18.50	117

*Constituent falls below guarantee.

ROCK AND POTASH

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	TYGERT-ALLEN BRANCH, PHILADELPHIA, PA.		
623	Allen's Alkaline Bone Phosphate,	R. S. MacMillan, Casselman,	12.32
533	†Allen's Star Soluble Bone Potash,	J. Singmaster, Macungie,	12.00
621		C. F. Raymond, Pugh,	
	WHEELER BRANCH, RUTLAND, VERMONT.		
331	†Wheeler's Wheat and Clover Fertilizer,	H. W. Chaffer, Orwell,	10.71
296		W. A. Fish, S. Montrose,	
301		T. A. Roberts, East Rush,	
620		C. A. Brandt & Sons, Shanksville,	
	WILLIAMS & CLARK BRANCH, NEW YORK.		
363	†Williams & Clark Dissolved Bone and Potash,	H. S. Tressler, Newport,	9.45
474		John Rockwell, Leroy,	
98		W. M. Atkinson, McVeytown,	
641		Jacob Kauffman, Jr., Davidsville,	
784		J. M. Fike, Bills,	
	ZELL BRANCH, BALTIMORE, MD.		
20	Zell's Dissolved Bone Phosphate and Potash,	O. F. Arnold, Clear Spring,	10.65
	THE ARMOUR FERTILIZER WORKS, CHICAGO, ILL.		
737	†Cereal Phosphate Fertilizer,	J. P. Stover, Clearfield,	11.53
350		McCalmont & Co., Bellefonte,	
755		Wallace Sherbine, Willmore,	
	BALTIMORE PULVERIZING CO, BALTIMORE, MD.		
519	†Penniman's Excelsior Fertilizer,	John W. Reutschler, Windsor Casle,	12.21
568		J. W. Goss, Mill Creek,	
90	†Special Spring Mixture,	Steininger Bros., Middleburg,	8.06
570		J. W. Goss, Mill Creek,	
	BAUGH & SONS CO., PHILADELPHIA, PA.		
208	†Soluble Alkaline Superphosphate,	J. W. Ruff, New Oxford,	13.12
780		C. H. Schmucker, Friedens,	
	A. H. BLAKER & CO., FOX CHASE, PA.		
26	Alkaline Bone Phosphate,	Patterson & Ramsey, Kelton,	11.63

For explanation of these tables see p. 713. †Composite sample.

FERTILIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.				Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
			Total.		Available.				Total.				
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.			
6.71	4.18	1.28	**12.17**	11.00	**10.89**	10.00	2.13	....	**2.13**	2.00	14.40	15.50	633
5.89	4.75	1.74	**12.38**	11.00	**10.64**	10.00	1.87	....	**1.87***	2.00	14.02	16.00	533
												15.00	621
7.08	3.43	.79	**11.30**	11.00	**10.51**	10.00	2.27	....	**2.27**	2.00	14.13	......	331
												16.00	296
												20.00	301
												17.00	620
6.35	4.99	1.09	**12.43**	11.00	**11.34**	10.00	2.08	....	**2.08**	2.00	14.52	14.00	363
												......	474
												15.50	98
												20.00	641
												16.00	784
7.55	4.39	.87	**12.81**	12.00	**11.94**	11.00	2.08	....	**2.09**	2.00	14.94	16.00	20
5.61	7.69	2.89	**16.19**	12.00	**13.30**	10.00	.56	....	**.56**	....	14.66	16.00	737
												12.00	350
												15.00	755
4.13	6.40	.83	**11.36**	11.00	**10.53**	10.00	3.00	....	**3.00**	2.50	14.58	......	519
												16.00	568
1.61	7.63	1.15	**10.39**	....	**9.24**	8.00	1.30	....	**1.30***	2.00	11.90	15.00	90
												14.00	570
3.80	6.88	1.79	**12.47**	....	**10.68**	10.00	2.17	....	**2.17**	2.00	14.10	14.00	208
												15.00	780
4.80	5.27	1.74	**11.81**	....	**10.07**	....	2.17	....	**2.17**	....	13.84	16.00	26

*Constituent falls below guarantee.

ROCK AND POTASH

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	BOWKER FERTILIZER CO., BOSTON & NEW YORK.		
335	†Empire State Bone and Potash,	P. H. Taylor, Wysox,	14.40
413		Jas. Bennett, Emlenton,	
	BRUMFIELD & FOSTER, COLORA, MD.		
70	Acid Phosphate and Potash,	Wilson & Me'nhall, Toughkenamon,	9.57
	E. FRANK COE CO., NEW YORK.		
314	Prize Brand Grain and Grass,	B. A. Cranmer, Monroeton,	10.88
	HENRY COPE & CO., LINCOLN UNVERSITY, PA.		
58	Soluble Bone and Potash,	Henry Cope & Co., Oxford,	9.55
	JOSIAH COPE & CO., LINCOLN UNIVERSITY, PA.		
51	†Soluble Bone and Potash,	Josiah Cope & Co., Oxford,	10.11
263		C. S. Dreiblebis, Shoemakersville,	
	JAS. G. DOWNWARD & CO., COATESVILLE, PA.		
35	Soluble Bone and Potash,	Thomas Agnew, Kelton,	9.97
	EUREKA FERTILIZER CO., PERRYVILLE, MD.		
513	†Alkaline Bone and Potash,	John G. Brown, Moyers,	12.10
787		Husband Grange, Husband,	
	W. S. FARMER & CO., BALTIMORE, MD.		
371	B. & P. Fertilizer,	J. L. Ritter & Son, Newport,	10.19
	GRIFFITH & BOYD, BALTIMORE, MD.		
573	XX Potash Manure,	E. A. Slagle, Paxinos,	13.50
	HANOVER FERTILIZER CO., BALTIMORE, MD.		
439	Royal Bone and Potash,	H. F. Gump, Everett,	10.58
	M. P. HUBBARD & CO., BALTIMORE, MD.		
2	Soluble Bone and Potash for Wheat and Grass,	E. A. Keasey,	13.60
[illegible]	Soluble Bone and Potash for Wheat and Grass,	R. F. Schwarz, Spragueville,	11.67
	PATAPSCO GUANO CO., BALTIMORE, MD.		
[illegible]	†Baltimore Soluble Phosphate,	J. N. Hersh, New Oxford,	11.02
[illegible]		W. F. Slagle, Bloomsburg,	

For explanation of these tables see p. 713. †Composite sampl

FERTILIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.				Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
			Total.		Available.				Total.				
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.			
3.38	5.31	1.72	10.41	....	8.69	8.00	3.15	....	3.15	3.00	13.86	......	335
												20.00	413
5.23	4.24	1.78	11.25	....	9.47	....	2.29	....	2.29	....	13.72	15.00	70
4.63	5.60	3.79	14.02	12.50	10.23*	10.50	1.95	....	1.95*	2.00	14.43	17.00	314
2.41	6.74	.65	9.80*	11.00	9.15*	10.00	3.94	....	3.94*	10.00	14.46	14.00	58
5.55	4.21	2.00	11.76	....	9.76*	10.00	2.30	....	2.30	2.00	13.99	14.00	51
												14.00	263
5.78	3.13	.90	9.76	....	8.86*	9.00	3.09	....	3.09	....	13.89	17.00	35
6.12	5.54	3.72	15.38	12.00	11.66	10.00	1.17	....	1.17*	2.00	14.67	14.00	513
												......	787
6.63	3.92	.73	11.28*	11.50	10.55	10.00	2.23	....	2.23	2.00	14.10	15.00	371
6.67	3.68	.88	11.23	11.00	10.35	10.00	5.36	....	5.36	5.00	17.19	20.00	573
2.73	6.61	1.69	11.03	10.00	9.34	9.00	2.00	....	2.00	1.00	12.99	17.00	439
8.51	2.74	.76	12.01	12.00	11.25	10.00	1.61	....	1.61*	2.00	14.08	20.00	2
6.88	3.83	.63	11.34*	12.00	10.71	10.00	1.78	....	1.78*	2.00	13.74	17.00	550
8.01	3.82	.70	12.53	12.00	11.83	11.00	2.05	....	2.05	2.00	14.82	18.00	205
												15.50	588

*Constituent falls below guarantee.

ROCK AND POTASH

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	RASIN-MONUMENTAL CO., BALTIMORE, MD.		
198	†Bone and Potash,	T. S. Patterson, East Berlin,	13.78
449		Cleaver & Gaily, Bedford,	
74		C. C. Katherman, Hartleton,	
591		H. R. Low, Orangeville,	
432	Special Formula for Corn and Buckwheat,	A. M. McClure, Everett,	15.14
	SCOTT FERTILIZER CO., ELKTON, MD.		
321	†Tip Top and Potash,	Jas. E. Eastman, Wysox,	12.61
326		C. W. Beers, Orwell,	
272	†Tip Top Soluble Bone and Potash,	D. K. Stein, Orwigsburg,	13.03
597		W. H. Diehl, Northumberland,	
	E. A. SLAGLE, PAXINOS, PA.		
406	Crop Grower,	E. A. Slagle, Paxinos,	12.03
	H. H. SMYSER, YORK, PA.		
500	Chicago Crop Grower,	H. H. Smyser, York,	14.38
	I. P. THOMAS & SON CO., PHILADELPHIA, PA.		
22	†Special Alkaline Bone,	J. A. Blackford,	13.60
333		E. D. Chaffer, Orwell,	
	JAMES THOMAS, WILLIAMSPORT, PA.		
107	†Dissolved Soluble Bone and Potash Phosphate,	Watt Bros., Bellville,	8.38
475		Elvin Allen & Co., Canton,	
	R. A. WOOLDRIDGE CO., BALTIMORE, MD.		
40	†German Potash Mixture,	Franklin G. Evans, Kelton,	12.02
370		J. L. Ritter & Son, Newport,	
264	†Liberty Bell Potash Mixture,	David Staler, Schuylkill Haven,	12.50
41		Franklin G. Evans, Kelton,	
375		G. L. Garman, Falling Springs,	
399		Jonathan Lambert, Lambertville,	
	YORK CHEMICAL WORKS, YORK, PA.		
13	Dempwolf's Black Cross,	A. K. Straley, Hall,	14.90
11	Dempwolf's Blue Cross Phosphate and Potash,	A. K. Straley, Hall,	13.57
213	Dempwolf's Red Cross Fertilizer,	Jesse L. Brodbeck, Hanover,	13.57

For explanation of these tables see p. 713. †Composite sample.

FERTILIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.				Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
			Total.		Available.				Total.				
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.			
5.42	4.99	1.64	**12.05**	11.00	**10.41**	10.00	1.68	....	**1.68***	2.00	13.63	14.00	198
												16.00	449
												14.60	74
												14.00	591
1.27	5.92	1.13	**8.32**	7.00	**7.19**	6.00	2.99	....	**2.99***	3.00	12.32	15.00	432
8.36	5.65	2.15	**16.16**	13.00	**14.01**	11.00	2.22	....	**2.22**	2.00	16.83	13.85	321
												17.00	326
8.46	5.56	2.39	**16.41**	13.00	**14.02**	11.00	2.19	....	**2.19**	2.00	16.93	14.00	272
												14.50	597
3.95	6.37	1.25	**11.57**	....	**10.32**	10.00	2.20	....	**2.20**	2.00	13.76	15.00	406
11.41	2.00	.57	**13.98**	....	**13.41**	10.00	2.73	....	**2.73**	2.00	16.83	15.00	500
2.25	7.29	2.45	**11.99***	12.00	**9.54***	10.00	4.79	....	**4.79**	4.00	16.18	16.00	22
												15.50	333
7.49	3.98	.96	**12.43**	12.00	**11.47**	11.00	2.01	....	**2.01**	2.00	14.79	14.00	107
												15.50	475
6.15	4.46	.89	**11.50**	....	**10.61**	10.00	2.17	....	**2.17**	2.00	14.62	15.00	40
												17.00	379
9.06	3.04	.60	**12.70**	....	**12.10**	12.00	2.76	....	**2.76***	3.00	15.78	16.00	264
												17.00	41
												18.00	375
												18.60	599
4.98	5.01	2.32	**12.31**	12.00	**9.99***	10.00	2.39	....	**2.39**	2.00	14.28	15.00	13
4.66	5.16	.87	**10.69***	12.00	**9.82***	10.00	10.20	....	**10.20**	10.00	21.57	22.00	11
2.57	7.07	2.50	**12.14**	12.00	**9.64***	10.00	5.08	....	**5.08**	5.00	16.62	16.00	213

*Constituent falls below guarantee.

DISSOLVED BONE

Furnishing Phosphoric

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	BAUGH & SONS CO., PHILADELPHIA, PA.	
492	Pure Dissolved Animal Bone,	S. M. Bailey & Bros., Dillsburg,

For explanation of these tables see p. 713. †Composite sample.

FERTILIZERS.

Acid and Nitrogen.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
				Total.		Available.						
	Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
9.11	1.60	12.95	3.82	18.37	....	14.55	13.00	2.12	2.06	29.00	28.00	492

*Constituent falls below guarantee.

GROUND BONE

Furnishing Phosphoric

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	ALLEGHENY CITY FERT. WKS., ALLEGHENY, PA.	
778	Butcher's Bone Meal,	Bloom & Kimball, Ebensburg,
779	Pure Raw Bone Meal,	Bloom & Kimball, Ebensburg,
	AMERICAN AGRI. CHEMICAL CO., NEW YORK.	
747	†Fine Ground Bone,	A. F. Stutzman, Johnstown,
799		King Bros., Uniontown,
753	Fine Ground Bone, 3x50,	Jacob Statler, Elton,
639	†Pure Ground Bone,	Jacob Kauffman, Jr., Davidsville,
666		H. M. Gray, Tyrone,
754	Pure Ground Bone, 4x45,	Jacob Statler, Elton,
	CANTON CHEMICAL BRANCH, BALTIMORE, MD.	
220	Baker's Standard Ground Bone,	G. B. Murphy, Keys,
	CHICOPEE GUANO BRANCH, NEW YORK.	
661	Chicopee Guano Pure Ground Bone,	H. B. Hickman & Son, West Chester,
	MILSOM BRANCH, EAST BUFFALO, N. Y.	
716	Milsom's Bone Meal,	Hetterbaugh & Downs, Sandy Lake,
	WILLIAMS & CLARK BRANCH, NEW YORK.	
364	Williams & Clark's Bone Meal, 2x30,	H. S. Tressler, Newport,
	AMERICAN REDUCTION CO., PITTSBURG, PA.	
136	Fine Ground Bone,	A. M. McClure, Everett,
	THE ARMOUR FERTILIZER WORKS, CHICAGO, ILL.	
145	†Bone Meal,	John S. Harshberger, Everett,
734		J. B. Staver, Clearfield,
72	Raw Bone Meal,	J. L. Ritter & Son, Newport,
	BAUGH & SONS CO., PHILADELPHIA, PA.	
81	Bone Meal,	C. H. Schmucker, Friedens,
	THE BERG CO., PHILADELPHIA, PA.	
54	Raw Bone Fine,	Ball & Rhodes, Media,
	A. H. BLAKER & CO., FOX CHASE, PA.	
65	Raw Bone Meal,	I. M. Hayburn, Brandywine Summit,

For explanation of these tables see p. 713. †Composite sample.

FERTILIZERS.

Acid and Nitrogen.

Moisture in 100 pounds.	Mechanical Analysis. Diameter less than 1-50 inch. "Fine."	Mechanical Analysis. Diameter greater than 1-50 inch. "Coarse."	Chemical Analysis. Phosphoric Acid. Found.	Chemical Analysis. Phosphoric Acid. Guaranteed.	Chemical Analysis. Nitrogen. Found.	Chemical Analysis. Nitrogen. Guaranteed.	Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
5.45	78	22	**18.94**	16.00	**4.09**	3.30	28.52	25.00	758
8.15	63	37	**23.12**	22.00	**3.60**	3.30	29.42	28.00	759
4.56	67	33	**26.58**	22.90	**2.72**	2.47	30.13	26.00	747
								28.00	799
3.95	82	18	**26.09**	22.90	**2.51**	2.47	30.38	25.00	753
7.52	60	40	**22.89**	20.61	**3.72**	3.30	29.30	28.00	639
								32.00	666
5.41	70	30	**23.74**	20.61	**3.87**	3.30	31.06	26.00	754
9.82	73	27	**20.52**	....	**3.06**	....	26.77	28.00	220
5.87	62	38	**25.75**	....	**2.97**	....	29.74	25.00	661
4.85	74	26	**21.37**	....	**2.32**	....	25.59	28.00	716
6.15	70	30	**18.28**	....	**2.71**	....	24.00	24.00	364
6.30	70	30	**20.84***	23.00	**3.63**	3.30	28.33	28.00	436
6.20	83	17	**25.18**	24.00	**3.33**	2.47	31.92	28.00	445
								33.00	734
5.28	74	26	**25.20**	22.00	**3.24***	3.71	30.98	28.00	372
7.95	73	27	**21.98**	21.50	**3.82**	3.50	29.79	28.00	781
7.19	59	41	**23.73**	20.00	**3.53***	4.00	29.49	30.00	154
5.55	52	48	**13.74**	....	**2.37**	....	18.82	27.00	664

*Constituent falls below guarantee.

GROUND BONE

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	BOWKER FERTILIZER CO., BOSTON, MASS.	
[illegible]	Bone Meal,	S. &. J. W. Stroh, Sunbury,
[illegible]	Bone,	Bailey & Converse, Wellsboro,
684	Pure Bone Meal,	Wrigley Hardware Co., Mahaffey,
	D. M. BOYD, JR., DANVILLE, PA.	
578	Pure Ground Bone,	J. H. Kase, S. Danville,
	CAMBRIA FERTILIZER CO., JOHNSTOWN, PA.	
566	†Pure Fine Ground Bone Dust,	John G. Simpson, Huntingdon,
763		H. A. Shoemaker, Ebensburg,
	JOSIAH COPE & CO., LINCOLN UNIVERSITY, PA.	
46	Pure Steamed Bone,	Josiah Cope & Co., Oxford,
[illegible]	Raw Ground Bone,	Chester Co. Association of Farmers, Kelton,
	JAS. G. DOWNWARD & CO., COATESVILLE, PA.	
[illegible]	Pure Ground Raw Bone,	Thomas Agnew, Kelton,
	EUREKA FERTILIZER CO., PERRYVILLE, MD.	
[illegible]	Ground Bone,	E. A. & J. L. Pennock, Chatham,
175	Ground Raw Bone,	E. A. & J. L. Pennock, Chatham,
	WASHINGTON EWING, LANDENBERG, PA.	
169	Pure Ground Raw Bone,	S. J. Chambers & Bros., West Grove,
	GRIFFITH & BOYD, BALTIMORE, MD.	
[illegible]	Pure Fine Ground Bone Meal,	Callahan & Bros., Wellsboro,
	HANOVER FERTILIZER CO., BALTIMORE, MD.	
[illegible]	Pure Bone Meal,	H. F. Gump, Everett,
	W. C. JONES SONS, DOE RUN, PA.	
180	Pure Ground Bone,	W. C. Jones' Sons, Doe Run,
	LACKAWANNA FERT. & CHEM. CO., MOOSIC, PA.	
595	Ground Bone,	W. H. Diehl, Northumberland,
121	†Warranted Pure Ground Bone,	G. R. Clark & Co., Scranton,
124		G. M. Hull, Oliphant,
	WM. C. NEWPORT CO., WILLOW GROVE, PA.	
186	Pure Bone Dust,	Isaac Parry, Ivyland,
649	Pure Raw Bone Meal,	Griffith & Wollerton, Downingtown,

For explanation of these tables see p. 713. †Composite sample.

FERTILIZERS—Continued.

Moisture in 100 pounds.	Mechanical Analysis.		Chemical Analysis.				Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
	Diameter less than 1-50 inch. "Fine."	Diameter greater than 1-50 inch. "Coarse."	Phosphoric Acid.		Nitrogen.				
			Found.	Guaranteed.	Found.	Guaranteed.			
4.05	50	50	25.46	....	2.44	....	27.43	28.00	393
3.70	62	38	26.07	....	1.39	....	26.14	35.00	357
7.68	63	37	23.12	....	3.54	....	29.31	30.00	634
6.50	36	64	21.75*	23.00	4.33	3.71	28.28	30.00	578
7.75	55	45	21.72	20.00	3.72	2.47	28.08	30.00	566
								28.00	763
6.95	92	8	25.79	25.00	2.40*	2.47	30.63	24.00	46
5.05	56	44	23.65	23.00	3.94	3.71	30.31	25.00	20
7.45	70	30	18.03*	20.00	3.77	3.30	26.44	29.00	22
9.63	84	16	27.75	22.00	1.79*	3.30	30.06	24.00	178
5.29	64	36	23.94	22.00	3.88	3.30	30.88	26.00	175
3.70	43	57	20.97	18.00	3.71	2.47	26.70	26.00	169
6.80	57	43	17.86*	21.00	4.71	3.30	27.80	30.00	553
6.28	72	28	20.51*	23.00	2.42*	3.30	25.08	29.00	441
5.44	65	35	23.39	22.00	3.09*	3.30	28.54	26.00	180
9.02	59	41	22.18*	23.00	4.15	3.71	29.80	30.00	595
5.20	51	49	23.36	23.00	4.23	3.71	30.28	30.00	121
								30.00	124
6.92	43	57	22.36	22.00	3.99	3.71	28.38	29.00	188
4.84	63	37	24.03	22.00	3.89	3.30	30.87	26.00	649

*Constituent falls below guarantee.

GROUND BONE

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	PATAPSCO GUANO CO., BALTIMORE, MD.	
385	Pure Ground Bone,	Jos. Burkholder, Hummelstown,
	PITTSBURG PROVISION CO., PITTSBURG, PA.	
437	Pure Raw Bone Meal,	A. M. McClure, Everett,
	PUGH & LYONS, OXFORD, PA.	
44	Ground Raw Bone,	S. R. Dickey & Co., Oxford,
	SWIFT & CO., CHICAGO, ILL.	
421	Bone Meal,	Craig Hardware Co., Mars,
57	Pure Raw Bone Meal,	Henry Cope & Co., Oxford,
182	†Pure Raw Bone Meal,	W. E. Baldwin, Embreeville,
745		J. M. Harshberger & Sons, Johnstown,
744	Pure Special Bone Meal,	J. M. Harshberger & Sons, Johnstown,
	EMIL WAHL, PHILADELPHIA, PA.	
146	†Button Bone Dust,	Wilson & Mendenhall, Toughkenamon,
647		S. C. Walker & Co., Chadd's Ford Jct.,
	ROBT. A. WOOLDRIDGE CO., BALTIMORE, MD.	
39	Pure Raw Bone,	Franklin G. Evans, Kelton,
37	Tuckahoe Bone Meal,	Franklin G. Evans, Kelton,

For explanation of these tables see p. 713. †Composite sample.

FERTILIZERS—Continued.

Moisture in 100 pounds.	Mechanical Analysis.		Chemical Analysis.				Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
	Diameter less than 1-50 inch. "Fine."	Diameter greater than inch. "Coarse."	Phosphoric Acid.		Nitrogen.				
			Found.	Guaranteed.	Found.	Guaranteed.			
5.61	69	31	**23.74**	20.62	**3.84**	3.71	30.98	28.00	385
4.81	88	12	**21.07***	26.00	**4.14**	3.71	30.99	28.00	437
7.43	64	36	**21.73**	20.00	**3.70**	3.30	28.71	27.00	44
4.26	88	12	**26.40**	25.00	**2.67**	2.47	31.48	26.00	421
4.73	60	40	**23.60**	23.00	**3.82**	3.71	30.08	25.00	57
6.60	56	44	**24.33***	25.00	**3.84**	2.47	30.41	27.00	182
								27.00	745
9.31	61	39	**33.60**	27.50	**.62***	.82	29.74	25.00	744
11.45	74	26	**23.72***	26.36	**3.39**	3.09	30.19	27.00	146
								25.00	647
4.44	80	20	**24.50**	20.61	**2.62***	3.71	29.23	28.00	39
6.45	70	30	**16.75**	14.00	**2.78**	....	23.06	24.00	37

*Constituent falls below guarantee.

ACIDULATED ROCK

Furnishing

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	AMERICAN AGRICUL. CHEMICAL CO., NEW YORK.	
	BRADLEY BRANCH, BOSTON, MASS.	
710		J. H. Sheffer, Knox,
325	†Bradley's Soluble Dissolved Bone,	Daniel Hurley, Myersburg,
730		C. Marshall, Luthersburg,
	CANTON CHEMICAL BRANCH, BALTIMORE, MD.	
602	Canton Chemical Baker's Dissolved Bone,	Josiah Specht, Kantner,
800	Canton Chemical Baker's Dissolved S. C. Bone,	King Bros., Uniontown,
453		H. M. Gray, Tyrone,
87	†Canton Chemical Baker's Dissolved Bone Phos-	W. B. Winey, Middleburg,
535	phate,	W. S. Weaver, Easton,
	CROCKER BRANCH, BUFFALO, N. Y.	
286	Crocker's Dissolved Bone Phosphate,	Wm. H. Riland, Friedensburg,
	DETRICK BRANCH, BALTIMORE, MD.	
62	Detrick's Dissolved S. C. Bone,	—— ————, Oxford,
	GREAT EASTERN BRANCH, RUTLAND, VT.	
91	Great Eastern Dissolved Bone Fertilizer,	Chas. Boyer, Paxtonville,
396		John Engel, Hummelstown,
540		Chas. H. Kichline, Island Park,
318	†Great Eastern Dissolved Bone,	M. A. Cranmer, Monroeton,
749		U. S. Grumblin, Elkton,
774		C. K. Anckney, Jenners,
	LAZARETTO BRANCH, BALTIMORE, MD.	
212		Z. H. Cashman, New Oxford,
174	†Lazaretto Dissolved Bone Phosphate,	S. K. Chambers & Bros., W. Grove,
229		Grove & Uffelman, Brogueville Sta.,
	MORO-PHILIS BRANCH, PHILADELPHIA, PA.	
278	†Moro-Philips Soluble Bone Phosphate,	J. W. Diehl, Orwigsburg,
396		Lemuel Campbell, Sunbury,

For explanation of these tables see p. 713. †Composite sample.

PHOSPHATES.

Phosphoric Acid.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
	Soluble in water.	Reverted.	Insoluble.	Total.		Available.				
				Found.	Guaranteed.	Found.	Guaranteed.			
									19.00	710
10.53	11.32	4.41	1.03	**16.76**	15.00	**15.73**	14.00	14.36	17.00	325
									16.00	730
11.16	13.00	3.09	.79	**16.88**	15.00	**16.09**	14.00	14.71	17.00	602
10.82	12.43	2.55	.24	**15.22**	15.00	**14.98**	14.00	13.76	14.00	800
									14.00	453
11.95	10.87	3.70	1.08	**15.65**	15.00	**14.57**	14.00	13.63	14.00	87
									16.00	535
10.44	10.05	5.42	.68	**16.15**	15.00	**15.47**	14.00	13.93	13.00	286
14.30	11.72	2.96	1.58	**16.26**	15.00	**14.68**	14.00	13.98	....	62
6.63	11.71	3.38	1.24	**16.33**	16.00	**15.09**	14.00	14.12	14.00	91
									....	386
									14.00	540
9.71	10.97	4.40	.94	**16.31**	16.00	**15.37**	14.00	14.07	....	318
									14.50	749
									15.50	774
									13.00	212
10.13	11.83	3.12	1.00	**15.95**	15.00	**14.95**	14.00	13.95	11.50	174
									12.25	229
11.87	9.67	4.92	1.02	**15.61**	15.00	**14.59**	14.00	13.48	14.00	278
									13.50	396

*Constituent falls below guarantee.

ACIDULATED ROCK

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	PACIFIC GUANO BRANCH, NEW YORK.	
[illegible]	Pacific Guano Dissolved Bone Phosphate,	A. D. Super, Friedensburg,
	PACKER'S UNION BRANCH, RUTLAND, VT.	
317	†Packer's Union Acidulated Bone,	Frank Wion, Bellefone,
19		J. W. Gladfelter, Rossville,
678		Grant Snowberger, Freedom,
	READ BRANCH, NEW YORK.	
267	Read's Acid Phosphate, 14 Per Cent.,	Andrew J. Potts, Orwigsburg,
	REESE BRANCH, BALTIMORE, MD.	
340	†Reese's Dissolved Phosphate of Lime,	D. W. Bradford, Centre Hall,
16		N. H. Spangler, Rossville,
151		Ball & Rhodes, Media,
	SHARPLESS & CARPENTER BRANCH, PHILA., PA.	
177	Sharpless & Carpenter's Acid Phosphate,	E. A. & J. L. Pennock, Chatham,
	STANDARD BRANCH, NEW YORK.	
2?8	†Standard Dissolved Bone Phosphate,	F. H. Reutschler, Hamburg,
497		E. A. Keasy, Dover,
	TYGERT-ALLEN BRANCH, PHILADELPHIA.	
634	Tygert-Allen's Howitz Acid Phosphate,	M. H. Matlack & Co., West Chester,
635	Tygert-Allen's Star Dissolved Bone Phosphate,	James Colborn, Ursina,
	WHEELER BRANCH, RUTLAND, VT.	
599	†Wheeler's Electric Dissolved Bone,	C. A. Brandt & Sons, Shanksville,
619		C. E. Watrous, Dimock,
	WILLIAMS & CLARK BRANCH, NEW YORK.	
640	Williams & Clark's Acorn Acid Phosphate,	Jacob Kauffman, Jr., Davidsville,
	ZELL BRANCH, BALTIMORE, MD.	
21	Zell's Dissolved Bone Phosphate,	O. F. Arnold, Clear Spring,
	ARMOUR FERTILIZER WORKS, CHICAGO, ILL.	
[illegible]	†Star Phosphate,	S. G. Updegraff, Williamsport,
411		John S. Hershberger, Everett,
215		Dutera & Easley, Hanover,
[illegible]		W. H. Diehl, Northumberland,
471		J. E. Hagey, Henrietta,

*Constituent falls below guarantee.

PHOSPHATES—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds. Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
10.86	9.25	5.03	1.06	**15.34**	15.00	**14.28**	14.00	13.28	13.00	282
									13.00	327
11.37	10.79	4.04	.66	**15.49***	16.00	**14.83**	14.00	13.65	12.50	19
									14.00	678
11.75	10.18	4.91	.62	**15.71**	15.00	**15.09**	14.00	13.70	14.00	267
									13.50	340
11.25	13.28	2.54	.51	**16.33**	15.00	**15.82**	14.00	14.49	12.50	16
									13.00	151
11.68	9.19	5.74	.73	**15.66**	15.00	**14.93**	14.00	13.53	11.50	177
10.90	12.16	3.16	.31	**15.63**	15.00	**15.32**	14.00	13.99	14.00	258
									12.50	497
11.63	7.74	6.71	.66	**15.11**	15.00	**14.45**	14.00	13.04	14.00	654
10.57	13.20	3.13	.81	**17.14**	15.00	**16.33**	14.00	14.89	16.00	635
8.72	9.48	4.96	1.39	**15.83***	16.00	**14.44**	14.00	13.52	13.00	299
									16.00	619
11.03	13.53	2.98	.76	**17.27**	15.00	**16.51**	14.00	15.01	15.00	640
10.54	13.53	2.78	.38	**16.69**	15.00	**16.31**	14.00	14.77	14.00	21
									15.00	355
									14.00	444
12.86	13.35	2.30	.55	**16.20**	16.00	**15.65**	14.00	14.40	13.00	215
									14.00	598
									14.00	671

*Constituent falls below guarantee.

ACIDULATED ROCK

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	BAUGH & SONS CO., PHILADELPHIA.	
209		J. U. Ruff, New Oxford,
433		A. M. McClure, Everett,
111	†High Grade Acid Phosphate,	G. C. Rice, Reedsville,
605		P. J. Blough, Hooversville,
786		Peter Fink, Somerset,
	A. H. BLAKER & CO., FOX CHASE, PA.	
25	Acid Phosphate,	Patterson Ramsey, Kelton,
	BOWKER FERTILIZER CO., BOSTON, MASS.	
394	Apex Bone Phosphate,	S. & J. W. Stroh, Sunbury,
353		Central Commission Co., Williamsport,
258		Bailey & Converse, Wellsboro,
249	†Dissolved Bone Phosphate,	Kauffman & Kurtz, Giegertown,
392		S. & J. W. Stroh, Sunbury,
464		H. M. Spalding & Son, Troy,
	E. FRANK COE CO., NEW YORK.	
813	High Grade Acid Phosphate,	B. A. Cranmer, Monroeton,
	HENRY COPE & COE, LINCOLN UNIVERSITY, PA.	
56	Acid Phosphate,	Henry Cope & Co., Oxford,
	JOSIAH COPE & CO., LINCOLN UNIVERSITY, PA.	
28	Acidulated Phosphate,	Chester Co. Ass'n of Farmers, Kelton,
	EUREKA FERTILIZER CO., PERRYVILLE, MD.	
43	P. & P. Superphosphate,	S. R. Dickey & Co., Oxford,
	W. S. FARMER & CO., BALTIMORE, MD.	
636	Dissolved S. C. Bone,	E. B. Nicholson, Confluence,
	GRIFFITH & BOYD, BALTIMORE, MD.	
722		Aaron & Kerr, Kingsville,
362	†High Grade Acid Phosphate,	H. R. Beal, Oriental,
806		A. Gaddis & Co., Uniontown,
812		G. L. Moore, Brownsville,
571	Original Superphosphate,	E. A. Slagle, Paxinos,

For explanation of these tables see p. 792. †Composite sample.

PHOSPHATES—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds. Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
9.80	11.52	3.03	1.63	16.18	....	14.55	14.00	13.92	13.00	209
									14.00	433
									13.00	111
									15.50	605
									14.00	736
10.90	9.26	4.91	1.14	15.31	15.00	14.17	14.00	13.22	12.00	25
14.65	5.98	3.57	.76	10.26	....	9.50	9.00	9.90	13.50	394
13.94	6.33	5.15	1.90	13.38	....	11.48	11.00	11.55	14.00	353
									18.00	358
									13.00	249
									14.00	392
									16.00	464
10.65	8.18	5.21	3.29	16.68	16.00	13.39*	14.00	13.41	15.00	313
11.23	3.05	12.25	1.31	16.61	15.00	15.30	14.00	13.22	11.50	56
13.00	12.87	2.29	.97	16.13	....	15.16	14.00	14.22	10.50	28
11.37	7.00	5.34	3.37	15.71*	16.00	12.34*	14.00	12.67	12.00	43
11.95	11.37	3.54	.51	15.42*	16.00	14.91	14.00	13.69	15.00	636
9.61	10.86	4.02	1.45	16.33	15.00	14.88	14.00	15.18	15.00	722
									13.00	362
									14.00	805
									16.00	813
10.88	4.24	6.31	4.75	15.30	13.00	10.55*	12.00	11.76	12.00	571

*Constituent falls below guarantee.

ACIDULATED ROCK

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	HANOVER FERTILIZER CO., BALTIMORE, MD.	
410	Acid Phosphate,	H. F. Gump, Everett,
201	Dissolved S. C. Rock,	H. F. Stambaugh, Abbottstown,
	W. C. JONES' SONS, DOE RUN, PA.	
181	H. G. Dissolved S. C. Rock,	W. C. Jones' Sons, Doe Run,
	WM. C. NEWPORT CO., WILLOW GROVE, PA.	
648	Clear Acid Phosphate,	Griffith & Wollerton, Downingtown,
	G. OBER & SONS CO., BALTIMORE, MD.	
99	Dissolved Bone Phosphate,	W. M. Atkinson, McVeytown,
	PATAPSCO GUANO CO., BALTIMORE, MD.	
206	†Patapsco Pure Dissolved S. C. Bone,	J. N. Hursh, New Oxford,
587		W. F. Slagle, Bloomsburg,
	R. H. POLLOCK, BALTIMORE, MD.	
102	†Dissolved S. C. Bone,	H. M. Owens & Co., Lewistown,
194		D. E. Brown, East Berlin,
66		——— ———, Oxford,
342		Jno. W. Dubbs, Bellefonte,
450		J. A. C. Rider, Tyrone,
	RASIN-MONUMENTAL CO., BALTIMORE, MD.	
226	†Acid Phosphate,	G. B. Murphy, Keys,
448		Cleaver & Gailey, Bedford,
	SCOTT FERTILIZING CO., ELKTON, MD.	
320	†Tip Top Soluble Bone,	Jas. E. Eastman, Wysox,
327		C. W. Beers, Orwell,
	SHENANDOAH FERT'ZER CO., SHENANDOAH, PA.	
510	Chemical Bone Phosphate,	William L. Fehr, Rock,
	CHAS. A. SICKLER & BRO., WILKES-BARRE, PA.	
125	Monarch Phosphate,	W. D. Spencer, Waverly,
	H. H. SMYSER, YORK, PA.	
501	Chicago Soluble Bone,	H. H. Smyser, York,
	SOUTHERN FERTILIZER CO., YORK, PA.	
269	Dissolved Bone Phosphate,	A. F. Kimmel, Orwigsburg,

For explanation of these tables see p. 713. †Composite sample.

PHOSPHATES—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds. Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
10.56	6.99	4.81	1.18	**12.98***	13.00	**11.80***	12.00	11.55	13.00	440
11.63	13.12	2.47	.84	**16.43**	15.00	**15.59**	14.00	14.46	13.00	201
10.70	11.88	3.00	1.25	**16.13**	16.00	**14.88***	15.00	14.02	11.50	181
10.65	2.46	9.05	2.62	**14.13***	16.00	**11.51***	15.00	11.36	13.00	648
6.60	6.65	9.68	1.58	**17.91**	16.00	**16.33**	14.00	14.37	14.00	99
8.93	11.69	4.42	.65	**16.76**	15.00	**16.11**	14.00	14.50	14.50	206
									13.00	587
11.22	11.65	3.56	.69	**15.90**	15.00	**15.21**	14.00	13.98	14.00	102
									13.00	134
									....	66
									14.00	342
									17.00	450
13.31	11.83	2.78	.69	**15.30***	16.00	**14.61***	15.00	13.64	13.50	226
									14.00	148
12.75	10.67	6.05	1.67	**18.39**	16.00	**16.72**	14.00	15.14	11.75	320
									17.00	327
12.08	3.93	5.21	2.25	**11.39***	15.00	**9.14***	14.00	9.98	14.00	510
7.05	4.18	7.11	2.19	**13.48**	....	**11.29***	14.00	11.28	13.00	125
11.61	13.04	2.88	.61	**16.53**	....	**15.92**	14.00	14.55	12.50	501
12.02	13.23	3.21	.41	**16.85**	15.00	**16.44**	14.00	14.80	14.00	269

*Constituent falls below guarantee.

ACIDULATED ROCK

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	JAMES THOMAS, WILLIAMSPORT, PA.	
462	Pure Dissolved Soluble Bone Phosphate,	Compton & Lilley, Troy,
	TUSCARORA FERTILIZER CO., PORT ROYAL, PA.	
75	†Tuscarora Bone Phosphate,	P. S. Haupt, Mifflinburg,
93		Samuel Shirey, Beaver Springs,
	YORK CHEMICAL WORKS, YORK, PA.	
14	Dempwolf's Dissolved Phosphate,	A. K. Straley, Hall,

For explanation of these tables see p. 713. †Composite sample.

FERTILIZERS—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
				Total.		Available.				
	Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.			
10.24	10.98	4.14	.64	**15.76**	15.00	**15.12**	14.00	13.82	16.00	462
10.57	3.99	4.52	4.82	**13.33**	8.00	**8.51**	7.00	10.54	15.00	75
									....	93
15.00	9.39	4.12	3.02	**16.53**	16.00	**13.51***	14.00	13.54	13.00	14

*Constituent falls below guarantee.

MISCELLANEOUS

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	AMERICAN AGRICUL. CHEMICAL CO., NEW YORK.		
366	German Kainit,	H. L. Tressler, Newport,	4.65
	CLARK'S COVE BRANCH, NEW YORK.		
404	Clark's Cove German Kainit,	A. Cameron Bobb, Paxinos,	7.17
	JOSIAH COPE & CO., LINCOLN UNIVERSITY, PA.		
31	Muriate of Potash,	Chester Co. As. of Farmers, Kelton,	2.80
27	Nitrate of Soda,	Chester Co. As. of Farmers, Kelton,	2.00
	JACOB REESE, PHILADELPHIA, PA.		
663*	Odorless Slag Phosphate,	Samuel L. Brinton, West Chester,	.28

For explanation of these tables see p. 713. †Composite sample.

*The phosphoric acid in basic slag is combined in a manner different from that in either dissolved or raw rock or bone; the slag phosphate is chiefly tetra-calcium phosphate. This is much more available to plants than the results of solution by water and ammonium citrate indicate.

†Though sold under the name "kainit," this is realy a higher grade of goods. The analysis corresponds with the article sold as "20 per cent. manure salt."

FERTILIZERS.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.				Nitrogen.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
......	......	......	....	......	....	......	......	......	....	......	....	......	....	14.00	366
......	......	......	....	......	....	......	21.49	......	**21.49**†	......	....	......	23.94	16.00	404
......	......	......	....	......	....	......	50.63	......	**50.63**	......	....	......	53.66	41.00	31
......	......	......	....	......	....	......	......	......	....	......	15.36	......	51.74	45.00	27
......	7.24	13.79*	**21.03**	18.00	....	......	......	......	**13.60**	12.00	....	......	15.87	14.00	663

ANALYSES OF FALL SAMPLES.

Tabulated Analyses of Commercial Fertilizers

FROM

SAMPLES SELECTED BY SPECIAL AGENTS

OF THE

Pennsylvania Department of Agriculture.

Analyses by DR. WILLIAM FREAR, Chemist of the Department, and of the State College Experiment Station, State College, Pa.

SAMPLES SELECTED FROM AUGUST 1, 1901, TO DECEMBER 31, 1901.

THE CHEMIST'S REPORT OF ANALYSES OF FERTILIZERS MADE FROM AUGUST 1, TO DECEMBER 31, 1901.

Hon. John Hamilton, Secretary of Agriculture:

During the six months ending December 31, 1901, there were received from the authorized sampling agents, five hundred and ninety-three (593) fertilizer samples, of which three hundred and eleven were subjected to analysis, the remainder being rejected either because they represented brands analyzed last spring, or because they were regarded as not certainly representative of the brand whose name they bore. When two or more samples representing the same brand were received, portions from the several samples were united and the composite sample was subjected to analysis.

The samples analyzed group themselves as follows: One hundred and seventy-nine complete fertilizers, furnishing phosphoric acid, potash and nitrogen; five dissolved bones, furnishing phosphoric acid and nitrogen; forty-two rock and potash fertilizers, furnishing phosphoric acid and potash; forty-nine acidulated rock phosphates, furnishing phosphoric acid only; thirty-three ground bones, furnishing phosphoric acid and nitrogen; three miscellaneous fertilizers, which group includes potash salts, nitrate of soda and other substances not readily classified under the foregoing heads.

The determinations to which a complete fertilizer is subjected are as follows: (1) Moisture, useful for the comparison of analyses, for indication of dry condition and fitness for drilling, and also of the conditions under which the fertilizer was kept in the warehouse. (2) Phosphoric acid—total, that portion soluble in water, and, of the residue, that portion not soluble in warm ammonium citrate solution (a solution supposed to represent the action of plant roots upon the fertilizer), which is assumed to have little immediate food value. By difference, it is easy to compute the so-called "reverted" acid, which is the portion insoluble in water but soluble in the citrate. The sum of the soluble and reverted is commonly called the "available" phosphoric acid. (3) Potash soluble in water,—most of that present in green sand marl and crushed minerals, and even some of that present in vegetable materials such as cotton-seed meal, not being included because insoluble in water even after long boiling. (4)

Nitrogen—this element is determined by a method which simply accounts for all present, without distinguishing between the quantities present in the several forms of ammonium salts, nitrates or organic matter. (5) Chlorin; this determination is made to afford a basis for estimating the proportion of the potash that is present as chlorid or muriate, the cheaper source. The computation is made on the assumption that the chlorin present, unless in excess, has been introduced in the form of muriate of potash; but doubtless there are occasional exceptions to this rule. One part of chlorin combines with 1.326 parts of potash to form the pure muriate; knowing the chlorin, it is, therefore, easy to compute the potash equivalent thereto. (7) In the case of ground bone, the state of sub-division is determined by sifting through accurately made sieves; the cost of preparation and especially the promptness of action of bone in the soil depends very largely on the fineness of its particles, the finer being much more quickly useful to the plant.

The law having required the manufacturer to guarantee the amount of certain valuable ingredients present in any brand he may put upon the market, chemical analysis is employed to verify the guarantees stamped upon the fertilizer sacks. It has, therefore, been deemed desirable in this report to enter the guaranty filed by the manufacturer in the office of the Secretary of Agriculture, in such connection with the analytical results that the two may be compared. An unfortunate practice has grown up among manufacturers of so wording the guaranty that it seems to declare the presence in the goods of an amount of a valuable constituent ranging from a certain minimum to a much higher maximum; thus, "Potash, 2 to 4 per cent." is a guaranty not infrequently given. In reality, the sole guaranty is for 2 per cent. The guaranteed amounts given for each brand in the following tables, are copied from the guaranties filed by the maker of the goods with the Secretary of Agriculture, the lowest figure given for any constituent being considered to be the amount guaranteed. For compactness and because no essentially important fact is suppressed thereby, the guaranties for soluble and reverted phosphoric acid have not been given separately, but are combined into a single guaranty for available phosphoric acid; in cases where the maker's guaranty does not specifically mention available phosphoric acid, the sum of the lowest figures given by him for soluble and reverted phosphoric acid is used. The law of 1879 allowed the maker to express his guaranty for nitrogen either in terms of that element or in terms of the ammonia equivalent thereto; since ammonia is composed of three parts of hydrogen and fourteen parts of nitrogen, it is a very simple matter to calculate the amount of one, when the amount of the other is given; the amount of nitrogen multi-

plied by 1.214 will give the corresponding amount of ammonia, and the amount of ammonia multiplied by 0.824 will give the corresponding amount of nitrogen. In these tables, the expression is in terms of nitrogen. The act of 1901 requires the guaranty to be expressed in terms of nitrogen, not ammonia. Many manufacturers after complying with the terms of the law, insert additional items in their guaranties, often with the result of misleading or confusing the buyer; the latter will do well to give heed to those items only that are given as the law requires and that are presented in these tables.

A summary of the analyses made this season may be presented as follows, excepting the miscellaneous class:

Summary of Analyses Made this Season.

	Complete fertilizers.	Dissolved bone.	Rock and potash.	Dissolved rock.	Ground bone.
Number of analyses,	179	5	42	49	33
Moisture, per cent.,	9.44	5.89	10.68	9.45	5.32
Phosphoric acid:					
Total, per cent.,	11.48	17.39	12.09	16.41	22.53
Soluble, per cent.,	4.89	2.11	5.35	9.81	....
Reverted, per cent.,	3.93	5.46	5.24	4.94	....
Insoluble, per cent.,	2.66	9.82	1.50	1.66	....
Potash, per cent.,	2.69	....	2.25	....	....
Nitrogen, per cent.,	1.37	2.45	....	....	2.94
Mechanical analyses of bone (per cent.):					
Fine,	....	....	....	....	69
Coarse,	....	....	....	....	31
Commercial valuation,	23.77	25.25	14.26	13.83	27.79
Average selling price,	22.28	23.91	16.09	13.18	25.94
Commercial value of samples whose selling price is ascertained,	23.75	23.36	14.23	13.82	27.69

The cases of departure of goods from their guaranteed composition observed this season, including only those cases in which it amounted to two-tents per cent. or more, were as follows::

Summary of Instances of Deficiency from Guaranty.

	Complete fertilizers.	Dissolved bone.	Rock and potash.	Dissolved rock.	Ground bone.
Deficient in four constituents,	1	....	....	....	....
Deficient in three constituents,	2	....	....	....	....
Deficient in two constituents,	20	1	1	....	....
Deficient in one constituent,	39	1	10	4	6
Total samples in which deficiency occurred,	62	2	11	4	6

The cases of deficiency noted during the past six seasons in the goods as compared with their guaranties, expressed in percentage of the total number of goods of each class analyzed, are as follows:

Percentages of Deficiency, 1899-1901.

	Spring, 1899.	Fall, 1899.	Spring, 1900.	Fall, 1900.	Spring, 1901.	Fall, 1901.
Complete fertilizer,	38.4	33.7	42.0	40.8	31.6	34.6
Dissolved bone,	50.0	14.3	*50.0	*50.0	†	40.0
Rock and potash,	19.1	34.2	29.2	33.3	31.7	26.2
Dissolved rock,	13.8	14.5	5.4	19.4	22.5	8.2
Ground bone,	18.4	25.3	36.7	11.8	34.1	18.2
All classes except miscellaneous,	30.9	29.2	35.2	34.3	30.8	27.6*

*Only two samples analyzed. †Only one sample analyzed.

These figures show changes from year to year; in 1900 there was an exceptional increase, both spring and fall, in such deficiencies; but, last spring, the number dropped back to normal; the past season makes the best showing, in this respect, that has been made for several years.

In most samples which are found below guaranty at one point, there is an excess at some other point, indicating that the cause of departure from the composition guaranteed lay not in the failure of the manufacturer to use the requisite components, but in his failure to secure a uniform mixture.

Considering all cases of complete fertilizers in which guaranties were strictly comparable with stated analytical results and sufficiently complete for the purpose: Eighty-eight such cases of deficiency occur; of these there are thirty-five in which the deficiency at one point is not counter-balanced by any very marked tendency to excess in the other constituents of the mixture, while fifty-three cases, or a little less than two-thirds of the entire number, exhibit distinctly such counterbalancing tendencies.

Of the eighty-nine cases, twenty-six show a total deficiency of 21.70 per cent. of available phosphoric acid, sixty two a total excess of 60.77 per cent. or a net excess for the average case of 0.44 per cent., in like manner the sum of the deficiencies in potash shown by forty samples is 27.60, the sum of excesses in forty-seven cases is 19.48, making an average net deficiency of 0.09 per cent.; and the sum of nitrogen deficiencies in sixty-three cases is 15.28, that of the excesses in twenty-four cases, 3.39, making an average net deficiency of 0.13

per cent. That is, the general tendency is to excess in the cheaper ingredient and deficiency in the more costly, in samples exhibiting deficiency at any point. The average value per ton of the excess available phosphoric acid is 41.8 cents; of the deficient potash and nitrogen, 49.2 cents; so that, in point of cost, these cases present an average deficiency in value at the point of shipment of only 7.4 cents per ton.

In the foregoing paragraphs consideration has been confined to samples that are at some point abnormal; about one-half the samples tested were up to or above guaranty at all points. The true average condition of the market for complete fertilizers will be more fairly exhibited by a comparison of the average composition of all samples for which guaranties are recorded with the average of the corresponding guaranties; they are as follows:

	Average composition found upon analysis. Per cent.	Average guaranty. Per cent.
Phosphoric acid:		
Total,	11.51	9.82
Available,	10.60	8.06
Potash,	2.77	2.66
Nitrogen,	1.39	1.39

In general then, the consumer receives, on the average, almost exactly the guarantied amounts of potash and nitrogen and a very liberal allowance of phosphoric acid of high availability.

It is of interest to note how closely the system of valuations, based upon the wholesale prices of raw materials in the principal markets during the most important buying season and upon certain average allowances for expense and profit on the part of the mixer and jobber, coincides with the retail prices later ascertained. A comparison for several seasons past is given below.

Comparison of Selling Prices and Valuations.

	Selling price.	Valuation.	Excess of valuation over selling price.
Complete fertilizers:			
1899, Spring,	$23.60	$24.53	$1.07
1899, Fall,	22.98	23.38	.49
1900, Spring,	25.38	24.59	—.79
1900, Fall,	23.22	23.84	.62
1901, Spring,	23.92	24.76	.84
1901, Fall,	22.28	23.75	1.47
Dissolved bone:			
1899, Spring,	21.75	21.75	....
1899, Fall,	19.00	22.30	3.30
1900, Spring,	26.00	26.26	.26
1900, Fall,	23.50	22.74	—.76
1901, Spring,	28.00	29.00	1.00
1901, Fall,	23.91	23.36	—.55
Rock and Potash:			
1899, Spring,	16.83	15.05	—1.78
1899, Fall,	17.28	14.53	—2.75
1900, Spring,	17.35	14.71	—2.64
1900, Fall,	18.11	14.63	—3.48
1901, Spring,	16.20	14.60	—1.60
1901, Fall,	16.09	14.23	—1.86
Dissolved Rock:			
1899, Spring,	13.36	14.02	.66
1899, Fall,	12.64	13.19	.55
1900, Spring,	13.57	13.49	—.08
1900, Fall,	13.96	13.11	—.85
1901, Spring,	13.90	13.51	—.39
1901, Fall,	13.18	13.82	.64
Ground Bone:			
1899, Spring,	26.67	28.06	1.39
1899, Fall,	24.98	27.37	2.39
1900, Spring,	28.42	25.81	—2.61
1900, Fall,	28.73	28.73	....
1901, Spring,	27.59	28.71	1.12
1901, Fall,	25.94	27.69	1.75

The analytical work has been performed by the following Assistant Chemists: Nitrogen, Mr. M. S. McDowell; soluble and insoluble phosphoric acid, Mr. C. W. Norris; potash and chlorin, Mr. M. H. Pingree; moisture and total phosphoric acid, Mr. N. W. Buckhout. The listing and preparation of samples were in charge of Mr. McDowell; the computation and care of records in charge of Miss M. Garner.

Respectfully submitted,

WM. FREAR.

December 31, 1901.

COMPLETE

Furnishing Phosphoric Acid,

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
	THE ABBOTT AND MARTIN RENDERING CO., COLUMBUS, OHIO.		
1143	Abbott's XX Brand,	Jackson & Mitchell, Butler, Pa.,	3.08
1144	Ideal Grain Grower,	Jackson & Mitchell, Butler, Pa.,	4.93
	ALLEGHENY CITY FERTILIZER WORKS, ALLEGHENY CITY, PA.		
825	Banner Phosphate,	R. English, Petrolia,	7.63
830	Potato Manure,	Wm. Snyder, Cowansville,	5.78
1142	Raw Bone Phosphate,	Wm. Watson & Son, Mt. Chestnut,	5.40
	THE ALLENTOWN MANUFACTURING CO., ALLENTOWN, PA.		
1323	†Complete Bone Phosphate,	David T. Barnett, Hanoverville,	7.87
1273		Robert C. Meek,	
1393		David T. Barnett, Bethlehem,	
1321	Special $25.00 Phosphate,	David T. Barnett, East Texas,	10.81
	THE AMERICAN AGRICULTURAL CHEMICAL CO., NEW YORK.		
1119	†Standard Guano,	E. S. Campbell, New Albany,	10.94
1245		G. W. Esenwine, Salons,	
	BRADLEY BRANCH, NEW YORK.		
1153	Bradley's Potato Fertilizer,	Eichholtz & Marshall, Zelionople,	15.60
	CANTON CHEMICAL BRANCH, BALTIMORE.		
1274	Canton-Chemical Bakers' Special Wheat, Corn and Grass Producer 1x9x2.	Forseman & Bros.,	11.32
	CLARK'S COVE BRANCH, NEW YORK.		
1062	Clark's Cove Defiance Fertilizer,	John Nealer, Indiana,	6.26
933	†Clark's Cove Defiance Complete Manure,	C. J. Bushey, Dillsburg,	7.57
1041		Jno. H. Way, Coleman,	

For explanation of these tables see p. 792. †Composite sample.

FERTILIZERS.

Potash and Nitrogen.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
1.38	5.02	1.98	8.38	7.00	6.40	6.00	1.12	......	1.12	1.00	.57	.41	15.87	20.00	1143
2.53	6.67	2.25	11.45	9.00	9.20	8.00	1.07	......	1.07	1.00	.95	.82	20.64	25.00	1144
1.90	4.06	7.17	13.13	9.00	*5.96	8.00	2.41	......	2.41	2.00	1.26	.82	21.76	24.00	825
5.78	2.77	6.03	14.58	9.00	8.55	8.00	3.55	......	*3.55	7.00	*2.31	2.47	29.70	25.00	830
4.61	3.61	6.50	14.72	10.00	*8.22	9.00	3.43	......	3.43	3.00	2.77	2.47	31.00	28.00	1142
														28.00	1323
5.31	4.33	3.23	*12.87	13.75	9.64	7.75	1.95	......	*1.95	2.00	*2.01	2.27	26.67†	......	1273
														28.00	1393
6.09	5.46	1.91	13.46	13.00	11.55	10.00	1.90	......	*1.90	2.00	*1.00	1.03	24.31	25.00	1321
6.30	3.30	1.99	11.59	......	9.60	......	2.43	......	2.43	......	1.18	......	23.59†	22.00	1119
														20.00	1245
1.87	6.20	3.03	11.10	9.00	8.07	8.00	2.74	......	*2.74	3.00	*1.70	2.06	25.32	25.00	1153
6.45	2.87	1.25	10.57	10.00	9.32	9.00	2.16	......	2.16	2.00	.89	.82	21.48	24.00	1274
4.66	4.28	1.45	10.39	8.00	8.94	7.00	1.28	......	1.28	1.00	.97	.82	20.30	16.00	1062
.89	7.10	2.48	10.47	8.00	7.99	7.00	1.13	......	1.13	1.00	.87	.82	18.76†	18.00	938
														20.00	1041

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
1270	Clark's Cove Defiance Manure 1x7x1,	Laurelton Store Co., Laurelton,	10.97
	CUMBERLAND BRANCH, NEW YORK.		
1040	Cumberland Hawkeye Fertilizer,	Saml. Shaffer, Stoystown,	10.48
	DETRICK BRANCH, BALTIMORE, MD.		
1145	Detrick's Imperial Compound,	George Dindinger, Harmony,	8.69
1123	Detrick's Paragon Ammoniated Bone Phosp'e Potash,	Barth & Kestor, Dushore,	12.95
1146	Detrick's Standard Potash,	George Dindinger, Harmony,	8.46
	LAZARETTO GUANO BRANCH, BALTIMORE, MD.		
958	Lazaretto Bone Compound,	Z. H. Cashman, New Oxford,	10.45
1263	Lazaretto Bone Compound, 1¼x9x3,	D. D. Manville & Son, Muncy,	10.64
885	†Lazaretto Excelsior A. A. A.,	John Wingert, Lewisburg,	9.03
1262	†Lazaretto Excelsior A. A. A.,	D. D. Manville & Son, Muncy,	9.03
	MARYLAND BRANCH, BALTIMORE, MD.		
1034	†Maryland Ammoniated Bone,	J. B. Zimmerman,	9.16
877	†Maryland Ammoniated Bone,	S. M. Shuler & Sons, Liverpool,	9.16
1203	†Maryland Ammoniated Bone,	P. B. Oswald, New Tripoli,	9.16
	MICHIGAN CARBON WORKS, BRANCH, DETROIT, MICH.		
1147	Michigan Homestead A Bone Black Fertilizer,	George Dindinger, Harmony,	9.79
1148	Michigan Red Line Complete Manure,	George Dindinger, Harmony,	9.30
	MILSON BRANCH, EAST BUFFALO, N. Y.		
826	Milsom's Pennsylvania Corn and Grain Grower,	Frank Atkins, Adams,	6.57
	MORO-PHILIPS BRANCH, PHILADELPHIA, PA.		
1231	Moro-Philips C. and G. Complete Fertilizer,	J. E. Bouse, Clement Station,	9.06
1226	Moro-Philips Standard Guano,	W. H. H. Meckley, Alburtis,	9.37
	NIAGARA BRANCH, BUFFALO, N. Y.		
1254	Niagara Triumph Fertilizer, 3x9x2,	C. D. Glossner, Jacksonville, Pa.,	9.53
	PACIFIC GUANO BRANCH, NEW YORK.		
1128	†Pacific Nobesque Guano,	John Persing, Nickelville,	9.96
1234	†Pacific Nobesque Guano,	J. W. Showalter,	9.96

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
[illegible]	[illegible]	1.1[illegible]	9.70	8.00	8.55	7.00	1.41	......	1.41	1.00	.88	.82	19.65	20.00	1270
5.50	2.87	.96	9.33	8.00	8.37	7.00	1.26	......	1.26	1.00	.92	.82	19.3[illegible]	18.50	1040
6.[illegible]	2.8[illegible]	2.46	11.65	9.00	9.19	8.00	2.72	......	2.72	2.00	1.06	.82	[illegible]	21.00	1145
3.17	[illegible]	3.19	10.70	8.00	7.51	7.00	1.42	......	1.42	1.00	.95	.82	19.[illegible]	20.00	1123
3.8[illegible]	3.87	1.4[illegible]	9.10	7.00	7.70	6.00	5.19	......	5.19	5.00	1.58	1.24	25.8[illegible]	24.00	1146
6.32	2.42	.99	10.23	10.00	9.24	9.00	3.07	......	3.07	3.00	1.03	1.03	22.77	22.00	958
7.41	1.84	1.42	10.67	10.00	9.25	9.00	3.05	......	3.05	3.00	1.06	1.03	23.10	22.00	1263
2.32	5.49	2.28	10.09	8.00	7.81	7.00	1.15	......	1.15	1.00	.93	.82	19.[illegible]	16.50	885
														18.00	1262
5.73	2.91	1.8[illegible]	10.49	9.00	8.64	8.00	3.25	......	3.25	3.00	1.70	1.65	25.16	22.50	1034
														22.00	877
														23.00	1203
5.74	2.85	2.73	11.32	9.00	8.59	8.00	1.85	......	1.85	1.50	*1.99	2.06	25.24	25.00	1147
4.73	3.79	1.77	10.27	8.00	8.52	7.00	1.38	......	1.38	1.00	.91	.82	19.87	21.00	1148
4.53	4.51	2.40	11.44	10.00	9.01	9.00	1.19	......	*1.19	2.00	*1.02	2.47	20.91	24.00	826
5.15	3.38	1.00	9.53	[illegible]	8.53	8.00	2.36	......	2.36	2.00	*.78	.82	2[illegible]	17.00	1231
5.03	3.76	1.86	10.65	9.00	8.79	8.00	3.58	......	*3.58	4.00	1.04	.82	23.11	25.00	1226
6.28	2.91	.93	10.22	10.00	9.29	9.00	2.23	...	2.23	2.00	*1.89	2.47	25.23	23.00	1254
5.95	3.32	1.44	10.71	9.00	9.27	8.00	2.09	......	2.09	2.00	*.95	1.03	21.60	24.00	1128
														22.00	1234

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
1129	Pacific Potato Phosphate,	John Persing,, Nickelville,	9.62
	REESE BRANCH, BALTIMORE, MD.		
973	†Reese's Half and Half,	William Oberdorff, Windsorville,	9.63
1319		Samuel Hummel, Monterey,	
1279	Reese's Harvest Queen,	G. W. Dick, Dillsburg,	9.50
974	Reese's Mayflower,	William Oberdorff, Windsorville,	12.62
941	†Reese's Pilgrim Fertilizer,	N. H. Spangler,	10.20
880		Isaac Shorts, Sunbury,	
1306		Samuel Hummel, Kutztown,	
	SHARPLESS AND CARPENTER BRANCH, PHILA.		
1316	Sharpless & Carpenter No. 2 for Grain and Grass,	L. A. Geiger, Joanna,	10.61
	STANDARD BRANCH, NEW YORK.		
1154	Standard Ammoniated Dissolved Bone,	Eicholtz & Marshell, Zelionople,	11.07
	SUSQUEHANNA BRANCH, BALTIMORE, MD.		
1335	Susquehanna Ammoniated Bone Phosphate,	George B. Passmore Sons, Oxford,	10.14
952	†Susquehanna Bone Phosphate,	James Law & Son, East Berlin,	8.90
1115		B. A. Cranmer, Monreton,	
1186		Solomon H. Lenhart, Hamburg,	
850		C. Neis, Geistown,	
1276		W. L. Mertz,	
1304		Wm. F. Terechel, Bethlehem,	
1320		Wm. Stimmel, Monterey,	
1336	Susquehanna Pure Bone Phosphate,	George B. Passmore Sons, Oxford,	9.78
	TYGERT-ALLEN BRANCH, PHILADELPHIA.		
1113	†Tygert-Allen Star Bone Phosphate.	P. L. Ward, South Towanda,	10.61
1218		Singmaster & Co., Macungie,	
1071		A. Sides & Co., Blairsville,	
1344		Wm. Smale, Springville,	
1397		D. G. Gross, Monocacy,	
1407		J. F. Beatty, Morton,	
1052	Tygert-Allen Star Guano,	A. F. Swank, Davidsville,	9.62

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds. Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash in 100 Pounds. (Water Soluble.) Present as muriate.	Present as sulphate.	Total. Found.	Total. Guaranteed.	Nitrogen in 100 Pounds. Found.	Guaranteed.	Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
5.53	4.37	2.08	**11.98**	7.00	**9.90**	6.00	1.33	3.34	***4.67**	5.00	***1.21**	1.24	23.58	26.00	1129
3.45	4.15	1.94	**9.44**	8.00	**7.50**	7.00	1.17	......	**1.17**	1.00	**.96**	.82	18.68	18.00	973
														20.00	1319
5.47	3.51	.76	**9.74**	9.00	**8.98**	8.00	2.01	......	**2.01**	2.00	***.93**	1.03	20.83	20.00	1279
5.66	3.08	.82	**9.56**	9.00	**8.74**	8.00	2.10	......	**2.10**	2.00	***1.09**	1.65	21.28	22.00	974
														20.50	941
5.38	3.30	1.46	**10.14**	9.00	**8.68**	8.00	3.63	......	***3.63**	4.00	**.96**	.82	22.51	21.00	880
														23.00	1306
2.88	3.67	2.73	**9.28**	8.00	***6.55**	7.00	1.08	......	**1.08**	1.00	**.84**	.82	17.54	18.00	1316
4.76	3.57	2.45	**10.78**	9.00	**8.33**	8.00	1.69	......	***1.69**	2.00	***1.12**	1.65	21.13	16.00	1154
3.37	4.58	3.23	**11.18**	9.00	***7.95**	8.00	2.24	......	**2.24**	2.00	**1.65**	1.65	23.58	22.00	1335
														21.50	952
														24.00	1115
														22.00	1186
4.16	4.13	3.20	**11.49**	9.00	**8.29**	8.00	2.30	......	**2.30**	2.00	**1.69**	1.65	24.28	28.00	850
														22.50	1276
														25.00	1304
														24.00	1320
4.58	4.59	3.70	**12.87**	11.00	**9.17**	9.00	2.50	......	**2.50**	2.00	**1.74**	1.65	25.88	25.00	1336
														25.00	1113
														25.00	1218
														26.00	1071
5.17	3.14	2.62	**10.93**	9.00	**8.31**	8.00	3.08	......	**3.08**	3.00	***1.91**	2.06	25.76	24.50	1344
														25.00	1397
														25.00	1407
6.55	2.69	1.03	**10.27**	9.00	**9.24**	8.00	3.27	......	**3.27**	3.00	***1.63**	2.06	25.30	24.00	1052

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
1283	Tygert-Allen Star Tobacco Manure,	H. C. Miller, Rohrerstown,	12.15
	WILLIAMS AND CLARK BRANCH, NEW YORK.		
823	Williams & Clark Americus Royal Bone,	Wm. McGinis, Crawford's Corners,	10.30
	ZELL BRANCH, BALTIMORE, MD.		
987	Zell's Ammoniated Bone Super-phosphate,	A. Hackenburg, Northumberland,	10.45
988	Zell's Economizer Phosphate,	A. Hackenburg, Northumberland,	8.34
1038		R. C. Heilley, Berlin,	
1072	†Zell's Little Giant,	Geo. J. New, Blairsville,	
1055		Jno. Campbell Heshbon, Mech'icsb'g,	7.39
1137		E. A. Watson, Isles,	
	AMERICAN REDUCTION CO., PITTSBURG, PA.		
1074	†Pittsburg Guano,	W. P. Dixon, Livermore,	6.49
1141		Wm. Watson & Son, Mt. Chestnut,	
	THE ARMOUR FERTILIZER WORKS, CHICAGO, ILL.		
1092	†Ammoniated Bone and Potash,	Smith & Sons, Mt. Pleasant,	6.87
1220		Wm. M. Gehman, Macungie,	
920	†Wheat Special,	McCalmont & Co., Bellefonte,	6.93
962		Dutterer & Easley, Hanover,	
871		J. L. Ritter & Son, Newport,	
986		A. Cameron Bobb, Paxinos,	
	BALTIMORE PULVERIZING CO., BALTIMORE, MD.		
1121	H. G. Wheat Compound,	A. B. Harnish, Mechanicsburg,	7.72
	BAUGH & SONS COMPANY, PHILADELPHIA, PA.		
976	Baugh's Animal Bone and Potash Compound,	W. W. Wise, Bridgeton,	10.68
959	†Baugh's Wheat Fertilizer for Wheat and Grass,	J. U. Ruff, New Oxford,	10.87
1042		Chas. H. Schmucker, Friedens,	
876		Samuel Shope, Hummelstown,	
1018		Wm. P. Hay, Lavansville,	
1229		Kerschner Bros., Breiningsville,	
1355		Dewees & Bracker, Paoli,	

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
4.90	3.17	1.68	**9.75**	9.00	**8.07**	8.00	3.20	......	**3.20**	3.00	***2.03**	2.06	25.61	28.00	1283
5.36	4.11	1.65	**11.12**	......	**9.47**	......	3.35	......	**3.35**	......	**.97**	......	23.11	23.00	823
4.90	3.95	2.43	**11.28**	9.00	**8.85**	8.00	2.36	......	**2.36**	2.00	***1.55**	1.65	21.08	20.00	987
1.57	6.07	2.76	**10.40**	9.00	***7.64**	8.00	1.75	......	***1.75**	2.00	***.79**	.82	19.04	19.00	988
														19.50	1038
5.21	4.99	1.76	**11.96**	8.00	**10.20**	7.00	1.46	......	**1.46**	1.00	**1.04**	.82	22.30	13.50	1072
														......	1055
														18.00	1137
8.33	4.37	.40	**13.10**	......	**12.70**	8.00	1.90	......	**1.90**	1.00	***.65**	1.24	23.76	......	1074
														19.00	1141
3.52	4.16	3.35	**11.03**	8.00	**7.68**	6.00	2.36	......	**2.36**	2.00	**2.88**	2.47	28.29	26.00	1092
														25.00	1220
2.37	5.29	4.61	**12.27**	10.00	**7.66**	8.00	1.33	......	**1.33**	1.00	**.87**	.82	19.80†	22.00	920
														18.00	962
														21.00	871
														20.00	986
5.92	3.19	2.51	**11.62**	......	**9.11**	......	2.27	......	**2.27**	......	**1.61**	......	21.57	20.00	1021
5.58	3.79	3.74	**13.11**	......	**9.37**	8.00	2.22	......	**2.22**	2.00	**2.42**	1.65	28.42	23.00	976
5.46	3.49	2.58	**11.53**	......	**8.95**	8.00	2.31	......	**2.34**	2.00	**1.69**	1.65	24.90	22.00	939
														22.00	1042
														21.00	876
														20.00	1018
														......	1229
														22.00	1355

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
	THE BERG CO., PHILADELPHIA, PA.		
1248		Harry Sands, Jersey Shore Junction,	
1300		Sprecher & Gantz, Lancaster,	
1214	†Berg's $25.00 Bone Manure,	F. P. Kletz, Neffs,	6.33
1308		James S. Heffner, Kutztown,	
1364		John W. Root, Kimberton,	
1249		Harry Sands, Jersey Short Junction,	
1195	†Berg's S. B. M. Standard Bone Manure,	M. C. Dietrich, Kempton,	7.23
1307		James S. Heffner, Kutztown,	
	BERGER BROS., EASTON, PA.		
1388	Wheat and Grass Special,	H. H. Bennett, Easton,	6.79
	A. H. BLAKER & CO., FOX CHASE, PHILADELPHIA, PA.		
1403	Blaker's Special Fertilizer for General Use,	Patterson & Ramsey, Jennersville,	10.75
1368	Blaker's Special for Wheat and Corn,	Linford Foulke, Quakertown,	13.71
	D. BLOCHER & CO., BALTIMORE, MD.		
1099	Dissolved Raw Bone and Potash,	John S. Hershberger, Everett,	9.20
	THE BOWKER FERTILIZER CO., BOSTON, MASS.		
1193	Bowker's Ammoniated Dissolved Bone,	M. C. Dietrich, Kempton,	11.39
	THE CHICAGO FERTILIZER CO., CHICAGO, ILL.		
1127	Mt. Pleasant Phosphate,	A. J. Andrews, Cochranton,	5.94
	HENRY COPE & CO., LINCOLN UNIVERSITY, PA.		
1166	Pennsylvania Wheat Grower and Complete Manure,	Henry Cope & Co., Oxford,	9.55
	J. A. CRANSTON CO., NEWPORT, DEL.		
1201	Pennsylvania Superior Phosphate,	H. F. Dungan,	9.70
1265	W. B. Raw Bone Super-phosphate,	H. F. Dungan,	9.08
	JAMES G. DOWNWARD & CO., COATESVILLE, PA.		
1342	Special Mixture,	Harry LeFevre, Chatham,	9.17

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.				
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.	Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
														25.00	[illegible]
														25.00	[illegible]
4.61	4.36	4.45	**13.42**	......	**8.97**	7.00	2.34	......	**2.34**	2.00	***1.54**	2.00	25.11	24.00	[illegible]
														24.00	[illegible]
														23.00	[illegible]
														32.00	[illegible]
3.52	5.12	5.10	**13.74**	......	**8.64**	8.00	6.57	......	**6.57**	6.00	***1.66**	3.00	29.64	30.00	[illegible]
														28.00	[illegible]
4.40	4.54	2.71	**11.65**	10.00	***8.94**	9.00	3.60	......	***3.60**	4.00	***1.20**	1.24	24.18	25.00	[illegible]
4.81	3.55	2.32	**10.68**	10 00	**8.36**	8.00	2.16	......	**2.16**	2.00	**1.11**	1.03	21.55	[illegible]	[illegible]
4.61	4.33	1.02	**9.96**	9.00	**8.94**	7.00	1.60	......	**1.60**	1.00	**.90**	.82	20.19	....	1368
9.00	2.09	.83	**11.92**	12.00	**11.09**	11.00	2.29	......	***2.29**	2.50	***1.69**	2.06	26.73	25.00	1099
3.74	5.20	2.94	**11.88**	......	***8.94**	11.00	1.17	......	**1.17**	......	**1.23**	......	21.91	28.00	1193
4.40	7.20	2.02	**13.62**	10.00	**11.60**	9.00	.50	......	**.50**	......	**.37**	......	13.27	14.00	1127
3.09	4.81	1.51	***9.41**	10.00	***7.90**	8.00	5.26	......	**5.26**	4.00	**1.32**	1.24	24.37	24.00	[illegible]
4.60	3.92	1.61	**10.13**	10.00	**8.52**	8.00	2.08	......	**2.08**	2.00	***.81**	1.03	20.18	[illegible]	1264
5.74	3.62	1.74	**11.10**	11.00	**9.36**	9.00	2.64	......	**2.64**	2.00	**1.42**	1.65	24.10	23.00	1265
3.63	3.22	8.26	**15.11**	......	**6.85**	......	2.05	......	**2.05**	......	**.67**	......	20.78	22.00	1342

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
	EUREKA FERTILIZER CO., PERRYVILLE, MD.		
869	†Farmers' Favorite Bone Phosphate,	Dimm & Keiser, Thompsontown,	9.16
1024		A. B. Harnish, Mechanicsburg,	
854		A. E. Marsh, Ebensburg,	
1076		Saml. P. Archibald, Livermore,	
1184		J. P. & A. S. Rentscheler, Hamburg,	
1415		Lewis H. Kirk & Co., Nottingham,	
870	†Grain and Grass Mixture,	Dimm & Keiser, Thompsontown,	7.19
1023		A. B. Harnish, Mechanicsburg,	
	FARMERS' FERTILIZER CO., COLUMBUS, OHIO.		
1081	Ammoniated Bone and Potash,	Jacob Weister, North Washington,	7.12
	FARMERS' FERTILIZER CO., WESTMINSTER, MD.		
933	No. 1 Bone Phosphate,	Cook, Deardorff & Co., Dillsburg,	9.05
	GRIFFITH & BOYD, BALTIMORE, MD.		
939	Ammoniated Bone Phosphate,	Henry Linebaugh, Roler,	10.65
1018	†Harvest Queen Phosphate,	A. B. Harnish, Mechanicsburg,	9.38
1078		Samuel Waddle, Tunnelton,	
1271	Soft Ground Bone,	Joseph Pinsley,	6.15
1019	Tiger Brand,	A. B. Harnish, Mechanicsburg,	11.71
	H. F. HAGER, QUAKERTOWN, PA.		
1371	Hager's Ammoniated Super-phosphate,	H. F. Hager, Quakertown,	11.10
1372	Farmer's Favorite Phosphate,	H. F. Hager, Quakertown,	7.54
1370	Panic Phosphate,	H. F. Hager, Quakertown,	8.82
	THOMAS HAINES & CO., MALVERN, PA.		
1354	New Century Crop Grower,	Thomas Haines & Co., Malvern,	11.23
	HANOVER FERTILIZER CO., BALTIMORE, MD.		
944	Blood and Bone Compound,	A. K. Straley, East Berlin,	7.64
971	Excelsior Combine,	Lebernight & Ferree, Red Lion,	7.33
	WILLIAM S. HASTINGS & SON, ATGLEN, PA.		
1176	Atglen Corn and Potato Guano,	Wm. S. Hastings & Son, Atglen,	6.92

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
4.41	4.70	3.34	**12.45**	10.00	**9.11**	8.00	2.02	......	**2.02**	2.00	***.95**	1.64	22.05	20.00	869
														20.00	1024
														22.00	874
														21.00	1676
														25.00	1184
														21.00	1415
5.18	4.73	3.20	**13.11**	9.00	**9.91**	8.00	.88	......	***.88**	2.00	**.85**	.82	21.44	19.75	870
														18.50	1023
5.52	4.62	1.91	**12.05**	......	**10.14**	......	3.41	......	**3.41**	......	**1.11**	......	24.63	25.00	1081
6.61	3.05	.74	***10.40**	11.00	**9.66**	9.00	3.06	......	**3.06**	2.50	***1.68**	2.06	25.62	21.50	933
7.08	2.57	2.39	**12.04**	9.00	**9.65**	8.00	2.04	......	**2.04**	2.00	***1.30**	1.65	23.91	23.50	939
7.17	3.47	3.23	**13.87**	11.50	**10.64**	10.00	2.66	......	**2.66**	2.50	***1.11**	1.24	25.21	21.00	1018
														22.00	1078
......	2.50	12.53	**15.03**	......	**2.50**	......	1.98	......	**1.98**	......	**2.17**	......	23.42	24.00	1271
5.96	3.20	2.63	**11.79**	11.00	**9.16**	9.00	3.98	......	**3.98**	3.00	**.86**	.82	23.61	[illegible]	1019
6.15	4.78	1.86	**12.79**	10.00	**10.93**	8.00	4.25	......	**4.25**	3.00	***2.41**	2.47	31.40	29.50	1371
4.43	3.56	2.05	**10.01**	10.00	***7.99**	8.00	2.49	......	**2.49**	2.00	**1.53**	1.24	23.07	23.00	1372
6.26	3.82	1.39	**11.47**	10.00	**10.08**	8.00	1.94	......	**1.94**	1.00	**.90**	.82	22.12	20.00	1370
6.74	2.27	1.40	**10.41**	......	**9.01**	9.00	2.67	......	**2.67**	2.00	**1.11**	.82	22.53	22.00	1354
1.63	5.81	2.49	**9.93**	a	**7.44**	a	2.99	......	**2.99**	2.00	**.85**	.82	20.17	18.00	944
3.17	4.28	4.44	**11.89**	......	**7.45**	......	1.98	......	***1.98**	2.00	***1.46**	1.65	23.57	24.00	971
8.54	4.05	3.64	**16.23**	......	**12.59**	7.00	5.29	......	**5.29**	5.00	**2.43**	1.65	36.56	26.00	1176

*Constituent falls below guarantee.
a Guaranty—Soluble, 8 per cent.; insoluble, 1 per cent.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
1175	Grain and Grass Special,	Wm. S. Hastings & Son, Atglen,	4.49
1173	Octororo Bone Phosphate,	Wm. S. Hastings & Son, Atglen,	10.23
	S. M. HESS & BRO., PHILADELPHIA, PA.		
1225	Ammoniated Bone Super-phosphate,	George W. Ruth, Alburtis,	9.50
1131	†Keystone Bone Phosphate,	J. N. Williamson, Harrisonville,	9.11
1017		A. L. Brubaker, Mechanicsburg,	
1191		Isaac S. Wenrich, Robesonia,	
1206		James S. Peters, Bests,	
1281	†Keystone No. 1 Bone Phosphate,	Levi Shuman, Mountville,	8.87
891		E. N. Klingler, Vicksburg,	
1339		Howard Townsend, Chatham,	
890	†Wheat and Grass Manure,	E. N. Klingler, Vicksburg,	9.33
1049		Jacob Kauffman, Jr., Johnstown,	
1205		Stephen Bachman, New Tripoli,	
874		C. L. Johnston, New Bloomfield,	
1302		P. R. R. Track, York,	
1312		S. H. Mast, Joanna,	
1338		Howard Townsend, Chatham,	
	M. P. HUBBARD & CO., BALTIMORE, MD.		
975	Harvest King for Wheat and Grass,	R. B. Hyson, Bridgeton,	8.79
	THE HUBBARD FERTILIZER CO., BALTIMORE, MD.		
983	†Hubbard's Columbia Gem Phosphate,	A. Cameron Bobb, Paxinos,	9.48
990		Bortnicr & Dietz, Danville,	
896	†Hubbard's Standard Bone Super-phosphate,	B. F. Keiser & W. C. Kline, Le'sb'g,	8.52
1269		Harvey Smith,	
898	Hubbard's Wheat Grower's Jewel,	B. F. Keiser & W. C. Kline, Le'sb'g,	11.34
	INTERNATIONAL SEED CO., ROCHESTER, N. Y.		
1091	†Grain and Grass Fertilizer,	E. D. Tinstonan, Herminie,	9.08
1309		F. W. Barndt, Quakertown,	

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 7[illegible].)	Selling price of 2,000 pounds at the point of selection.	Sample number.
Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Present as muriate.	Present as sulphate.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.			
8.40	4.63	6.31	**19.34**	12.00	**13.03**	10.00	4.29	......	**4.29**	2.00	**2.51**	1.03	37.29	20.00	1175
6.05	4.00	2.88	**12.93**	......	**10.05**	8.00	2.40	.67	**3.07**	3.00	**1.66**	1.65	26.94	25.00	1173
4.18	3.65	3.45	**11.28**	9.00	***7.83**	8.00	2.16	......	**2.16**	2.00	**1.73**	1.65	23.96	27.00	1225
5.21	2.97	2.71	**10.89**	9.00	**8.18**	8.00	1.45	......	**1.45**	1.00	**.97**	.82	20.30	23.00	1131
														22.00	1017
														21.00	1191
														20.00	1206
5.13	2.90	3.68	**11.71**	9.00	**8.03**	8.00	1.74	......	**1.74**	1.00	**1.01**	.82	21.09	15.00	1281
														19.00	891
														21.00	1339
6.48	2.57	1.34	**10.39**	9.00	**9.05**	8.00	2.31	......	**2.31**	2.00	**1.00**	.82	21.80	21.00	890
														......	1049
														22.00	1265
														22.00	874
														......	1302
														22.00	1312
														23.00	1338
7.09	3.43	2.18	**12.70**	a	**10.52**	a	1.61	......	**1.61**	1.50	**1.41**	1.24	24.69	20.00	975
2.26	5.51	3.65	**11.42**	......	**7.77**	......	1.47	......	**1.47**	......	**.78**	......	19.34	18.00	983
														18.00	990
2.18	5.36	3.48	**11.02**	......	**7.54**	......	3.68	......	**3.68**	......	**1.73**	......	24.98	22.00	896
														19.50	1269
7.21	2.59	2.47	**12.27**	......	**9.80**	9.00	2.39	......	**2.39**	2.00	**1.27**	1.24	24.27	20.00	898
7.09	2.74	3.07	**12.90**	11.00	**9.83**	10.00	2.07	......	**2.07**	2.00	**1.70**	1.65	26.98	......	1091
														28.00	1269

*Constituent falls below guarantee.
a Guaranty—Soluble, 9 per cent.; insoluble, 1.5 per cent.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
	JARECKI CHEMICAL CO., SANDUSKY, OHIO.		
1133	No. 1 Fish Guano,	G. A. Blair, Wesley,	9.95
842	Fish and Potash Grain Special,	Sample & Jones, Corry,	10.32
	LACKAWANNA FERTILIZER AND CHEMICAL CO., MOOSIC, PA.		
892	Moosic Phosphate,	Laurelton Store Co., Laurelton,	9.03
	LANCASTER CHEMICAL CO., LANCASTER, PA.		
1295	No. 2 Dewey Brand,	Henry Hershey, Dillersville,	12.28
1297	No. 3 Pure Dissolved Animal Bone and Potash,	Henry Hershey, Dillersville,	11.59
1298	No. 4 Rising Sun Animal Bone Phosphate,	Henry Hershey, Dillersville,	8.70
1296	No. 5 Flag Brand Super-phosphate,	Henry Hershey, Dillersville,	11.68
1299	No. 6 Hard Times Fertilizer,	Martin E. Rupp, Dillersvile,	11.67
	A. B. LETHERBURY, CHESTER, PA.		
1406	Chester Brand Bone Phosphate,	A. B. Letherbury, Chester,	13.65
	LISTER'S AGRICULTURAL CHEMICAL WORKS, NEWARK, N. J.		
1385	Cauliflower and Cabbage,	David Sterner, Allentown,	10.79
1391	Lawn Fertilizer,	E. J. Gerlach, Bethlehem,	8.57
1394	Potato No. 2 Fertilizer,	David Sterner, Allentown,	12.61
1389	Special Wheat Fertilizer,	E. J. Gerlach, Bethlehem,	9.12
1357	U. S. Phosphate,	Wm. H. Fritz, Berwyn,	10.84
1[illegible]67	†U. S. Super-phosphate,	Frank Douglass, Indiana,	
13[illegible]		E. J. Gerlach, Bethlehem,	
[illegible]	Wheat and Rye Fertilizer,	Frank Douglass, Indiana,	7.77
	MAPES FORMULA AND PERUNAN GUANO CO., NEW YORK.		
1025	†Complete Manure A Brand,	E. W. Rupp, Shiremanstown,	8.52
1401		Swartley Bros., Doylestown,	
1288	Tobacco Manure, Wrapper Brand,	Eli M. Martin, New Holland,	7.98
1112	Tobacco Starter,	R. M. Wells, South Towanda,	11.35

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.				
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.	Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
5.79	1.83	3.2[illegible]	**13.85**	11.00	**10.62**	10.00	.86	......	***.86**	1.00	**.89**	.82	22.46	[illegible]	113[illegible]
7.63	3.89	3.05	**14.57**	10.00	**11.52**	9.00	1.82	......	**1.82**	2.00	**1.39**	1.24	26.41	25.00	842
5.17	3.54	2.31	**11.02**	9.00	**8.71**	7.00	1.76	......	**1.76**	1.50	**1.63**	1.24	23.65	17.50	892
2.52	5.88	1.69	**10.09**	9.00	**8.40**	8.00	4.06	......	**4.06**	4.00	***1.11**	1.24	23.13	23.00	1295
5.60	4.77	1.78	**12.15**	11.00	**10.37**	10.00	4.91	......	***4.91**	5.00	***1.61**	1.65	28.27	27.00	1297
4.85	4.95	2.57	**12.37**	11.00	**9.80**	10.00	2.08	......	**2.08**	2.00	**2.69**	2.47	29.31	26.00	1298
3.15	5.36	2.11	**10.62**	9.00	**8.51**	8.00	2.53	......	**2.53**	2.60	**1.32**	1.24	22.57	21.00	1296
3.79	6.25	1.90	**11.94**	9.00	**10.04**	8.00	1.70	......	***1.70**	2.00	**.48**	.41	15.24	16.00	1299
7.46	1.87	1.02	**10.35**	9.50	**9.33**	8.00	1.50	......	**1.50**	1.50	***1.11**	1.24	21.63	28.00	1406
6.60	2.13	2.19	**10.92**	......	**8.73**	......	7.07	......	**7.07**	......	**3.13**	......	31.93	....	1395
5.14	3.80	3.27	**12.21**	9.00	**8.94**	8.00	2.93	......	***2.93**	3.00	***1.57**	1.65	25.21	28.00	13[illegible]1
8.04	2.81	2.15	**13.30**	11.00	**10.85**	10.00	2.13	1.43	***3.56**	4.00	**1.75**	1.65	28.87	....	1394
5.38	3.92	2.90	**12.29**	9.20	**9.30**	8.00	2.67	.84	**3.01**	2.00	***1.62**	1.65	25.80	22.00	1389
6.63	2.80	2.67	**12.10**	9.00	**9.43**	8.00	1.20	.97	**2.17**	2.00	**1.07**	1.03	22.07	24.00	1357
5.47	3.51	2.82	**11.80**	9.00	**8.98**	8.00	.80	1.29	**2.09**	2.00	**1.06**	1.03	22.[illegible]	24.00 20.00	1067 1390
5.40	3.33	3.90	**12.63**	9.20	**8.73**	8.00	2.05	......	**2.05**	2.00	***1.59**	1.65	21.61	25.00	1066
4.27	5.73	3.63	**13.63**	12.00	**10.00**	10.00	3.16	......	**3.16**	2.50	**2.76**	2.47	31.24	32.00	1025 1401
.57	3.35	2.04	**5.96**	......	***3.92**	4.50	9.87	......	***9.87**	10.50	***6.13**	6.18	45.16	47.00	1288
.20	4.98	4.27	**9.45**	8.00	**5.18**	6.00	1.94	......	**1.94**	1.00	**4.16**	4.12	20.36	37.00	1112

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
	MILLER FERTILIZER CO., BALTIMORE, MD.		
1001	†Harvest Queen,	W. F. Slagle, Bloomsburg,	9.03
904		J. W. Painter, Lewisburg,	
1179		M. T. Harkins, Hickory Hill,	
1261		Central Commission Co., Williamsp't,	
1180	†Hustler Phosphate,	M. T. Harkins, Hickory Hill,	8.48
902		J. W. Painter, Red Top,	
1260		Central Commission Co., Williamsp't,	
945	†Standard Phosphate,	Henry Linebaugh, East Berlin,	10.46
1032		J. R. Miller, New Kingston,	
1000	†W. G. Phosphate,	W. F. Slagle, Bloomsburg,	6.71
967		Jesse L. Brodbeck, Hanover,	
1329		M. T. Harkins, Hickory Hill,	
	WILLIAM C. NEWPORT CO., WILLOW GROVE, PA.		
994	†No. 1 Bone Phosphate,	John Bowden, Union Corners,	10.94
936		Cook, Deardorff & Co., Dillsburg,	
1256		Chas. L. Friller & Co., Williamsport,	
1351		Griffith & Wollerton, Downingtown,	
1257	Farmer's Ammoniated Bone Phosphate,	Chas. L. Friller & Co., Williamsport,	7.25
995	†Farmer's Ammoniated Bone Phosphate,	John Bowden, Union Corners,	12.01
1182		Geo. K. Linderman, Geigertown,	
1219		Wm. M. Gehman, Macungie,	
934		Cook, Deardorff & Co., Dillsburg,	
1292		N. H. Sprecher, Ephrata,	
1350		Griffith & Wollerton, Downingtown,	
1160		J. J. White, Lansdale,	
1177	Evan's Brand Potato and Tobacco Manure,	Wm. S. Hastings & Son, Atglen,	4.63

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds. Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash in 100 Pounds. (Water Soluble.) Present as muriate.	Present as sulphate.	Total. Found.	Total. Guaranteed.	Nitrogen in 100 Pounds. Found.	Guaranteed.	Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
6.76	4.16	1.45	12.37	11.50	10.92	10.00	2.11	......	*2.11	2.25	*.93	1.03	23.48	22.00	1001
														22.00	904
														24.50	1179
														20.00	1261
4.62	4.83	1.68	11.13	10.00	9.45	8.00	1.18	......	1.18	1.00	.86	.82	20.47	22.00	1180
														20.00	902
														20.00	1260
6.01	2.94	1.51	10.46	10.00	8.95	8.00	3.07	.33	3.40	3.00	2.52	2.47	28.64	25.00	915
														25.00	1032
2.79	4.97	1.65	9.41	9.00	7.76	7.00	1.12	......	1.12	1.00	.62	.41	17.34	20.00	1000
														16.50	967
														18.00	1329
5.97	4.48	1.91	12.36	10.00	10.45	8.00	.67	.65	*1.32	2.00	*1.20	1.65	23.36	21.50	994
														20.50	936
														22.00	1256
														24.00	1351
6.98	3.46	1.89	12.33	9.00	10.44	7.00	6.33	......	6.33	4.00	2.87	.82	34.87	21.00	1257
3.89	3.94	1.59	9.42	9.00	7.83	7.00	3.69	......	*3.69	4.00	1.13	.82	22.29	20.50	935
														20.00	1182
														23.00	1219
														19.50	934
														22.00	1292
														20.00	1350
														12.00	14.00
5.48	2.57	1.74	9.79	8.00	8.05	6.00	14.00	......	14.00	10.00	3.58	3.30	45.22	33.00	1177

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
993		John Bowden, Union Corners,	
1028		W. H. Zearing, Shiremanstown,	
1047		H. F. Sipe, Somerset,	
1174		W. S. Hastings & Son, Atglen,	
883	†Special Compound for Wheat and Grass,	A. C. Robb, Paxinos,	11.80
1258		Chas. L. Friller & Co., Williamsport,	
1291		N. H. Sprecher, Ephrata,	
1303		J. J. Nieman, Bethlehem,	
1322		John Kunkle, Bath,	
	OHIO FARMER'S FERTILIZER CO., COLUMBUS, OHIO.		
111	C. O. & W. Fish Guano,	Thomas Lloyd, Brisbin,	9.78
1109	General Crop Fish Guano,	Thomas Lloyd, Brisbin,	7.02
828	†Improved Wheat Maker,	Frank Atkins, Adams county,	10.73
1107		Thomas Lloyd, Brisbin,	
	PATAPSCO GUANO CO., BALTIMORE, MD.		
999		W. F. Slagle, Bloomsburg,	
873	†Fish Guano,	Jacob Fretz, New Bloomfield,	10.09
1211		Elias Wotring Sons, Germanville,	
911		Lincoln Musser, Fillmore,	
996		W. F. Slagle, Bloomsburg,	
878	†Grain and Grass Producer,	H. J. Moyer, Elizabethville,	8.77
1210		Elias Wotring Sons, Germanville,	
1228		J. H. Rupert, Huntingdon,	
977	†Grange Mixture,	P. A. Geasey, York,	10.10
997		W. F. Slagle, Bloomsburg,	
912		Lincoln Musser,	
879	†Patapsco Special Wheat Compound,	H. J. Moyer, Elizabethville,	10.22
1212		Elias Wotring Sons, Germanville,	
	J. D. PERKINS, COATESVILLE, PA.		
1346	Ammoniated Bone Phosphate,	J. D. Perkins, Coatesville,	12.27

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
														20.50	993
														20.00	1028
														19.00	1047
														20.00	1174
6.15	4.21	2.10	**12.44**	12.00	**10.34**	10.00	.80	.42	***1.22**	2.00	**1.07**	1.03	22.65	20.00	883
														20.00	1258
														20.00	1291
														22.00	1303
														20.00	1322
1.20	4.77	1.43	**10.40**	10.00	**8.97**	8.00	1.52	......	***1.52**	2.00	**1.26**	1.24	21.61	24.00	1111
.92	6.59	2.32	***9.83**	10.00	***7.51**	8.00	1.13	......	**1.13**	1.00	**.85**	.82	18.21	22.00	1109
														24.00	828
1.10	6.72	1.97	***9.79**	10.00	***7.82**	8.00	2.14	......	**2.14**	2.50	**.56**	.41	18.26		
														25.00	11[illegible]7
														20.00	999
6.17	2.33	1.03	**9.53**	7.00	**8.50**	6.00	2.49	......	**2.49**	2.00	***1.60**	1.65	23.53	21.00	873
														20.00	1211
														23.00	911
														21.00	996
5.17	2.17	.74	***9.08**	10.00	**8.34**	8.00	4.08	......	**4.08**	4.00	**.94**	.82	22.24	19.50	878
														20.50	1210
														20.00	1238
														23.00	977
6.89	2.73	.87	***10.49**	12.50	***9.62**	10.00	2.20	......	**2.20**	2.00	***1.64**	1.65	24.64		
														22.00	997
														25.00	912
7.36	3.03	2.82	***13.21**	14.00	**10.39**	9.00	3.04	......	**3.04**	2.50	**1.88**	1.85	28.26	23.00	879
														25.00	1213
8.10	2.99	.91	**12.00**	......	**11.09**	10.00	2.91	......	***2.91**	3.00	**1.05**	.82	24.79	....	1346

*Constituent falls below guarantee.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
1347	Monarch Phosphate,	J. D. Perkins, Coatesville	9.16
1345	Special Bone Manure,	J. D. Perkins, Coatesville,	9.77
	THE PIEDMONT-MOUNT AIRY GUANO CO., BALTIMORE, MD.		
1202	Leverings Ammoniated Bone,	P. B. Oswald, New Tripoli,	13.02
1241	Leverings Harvest Queen,	J. G. Simpson, Huntingdon,	12.55
1051	Pure Raw Bone Mixture,	Jno. Weaver, Davidsville,	12.48
1201	Piedmont Royal Ammoniated Bone and Potash,	P. B. Oswald, New Tripoli,	6.55
	R. H. POLLOCK, BALTIMORE, MD.		
951		D. E. Broim, East Berlin,	
1102		J. A. C. Rider, Tyrone,	
921	†Owl Brand Guano,	John G. Dubbs, Bellefonte,	7.46
1188		A. F. Baver, Windsor Castle,	
1387		Jerome S. Williams, Stroudsburg,	
1016		J. W. Simmons, Mechanicsburg,	
1103		J. A. C. Rider, Tyrone,	
922	†Special Wheat Grower,	John G. Dubbs, Bellefonte,	7.55
1189		A. F. Baver, Windsor Castle,	
1386		Jerome S. Williams, Stroudsburg,	
	RAMSBURG FERTILIZER CO., FREDERICK, MD.		
963	Ammoniated Bone Phosphate,	Duttera & Easley, Hanover,	10.84
965	Old Virginia Compound,	Duttera & Easley, Hanover,	9.79
	RASIN-MONUMENTAL CO., BALTIMORE, MD.		
[illegible]	Arundel Complete,	H. M. Sundy, York,	12.[illegible]
943	Dissolved Bone,	Bushey & Patterson, East Berlin,	9.78
	READING CHEMICAL AND FERTILIZER CO., READING, PA.		
1373	Mt. Penn Brand Fertilizer,	Harry C. Moyer, Blooming Glen,	10.13
1204	†Neversink Fertilizer,	D. A. Bachman, New Tripoli,	9.82
1315		Saml. Neathock, Joana,	

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
7.88	3.17	2.19	**13.21**	......	**11.05**	10.00	7.01	......	**7.01**	7.00	**.92**	.82	28.91	....	1347
5.44	2.95	3.64	**12.03**	......	**8.39**	8.00	1.50	......	**1.50**	1.00	**1.04**	.82	21.45	....	1345
5.02	4.14	1.87	**11.03**	......	**9.16**	......	3.47	......	**3.47**	......	**.91**	......	22.81	22.00	1262
4.56	3.51	2.62	**10.69**	......	**8.07**	8.00	2.22	......	**2.22**	2.00	***.71**	.82	19.84	22.00	1241
4.64	3.18	5.00	**12.82**	......	***7.82**	8.00	2.09	......	**2.09**	1.50	***.99**	1.03	21.78	....	1251
1.61	4.60	2.48	**8.69**	......	**6.21**	6.00	3.32	......	**3.32**	3.00	***.99**	1.07	19.70	21.00	1291
														18.00	951
														19.00	1162
1.58	5.41	1.76	**8.75**	a	**6.99**	a	1.60	1.58	**3.18**	1.50	**.48**	.41	18.46	16.00	921
														16.50	1188
														18.00	1387
														18.00	1016
														21.50	1103
1.40	5.26	3.06	**9.72**	b	**6.66**	b	2.56	......	**2.56**	2.00	**.87**	.82	19.09	20.00	922
														18.50	1189
														21.00	1386
4.80	5.66	4.26	**14.72**	12.00	**10.46**	10.00	1.46	......	***1.46**	2.00	***.72**	.82	22.47	18.00	963
2.90	6.16	3.54	**12.60**	12.00	**9.06**	9.00	2.08	......	**2.08**	2.00	***1.23**	1.24	23.18	19.00	965
5.70	2.82	1.48	**10.00**	......	**8.52**	8.00	2.28	......	**2.28**	2.00	***1.54**	1.65	23.29	21.00	988
7.68	3.19	3.11	**13.98**	12.00	**10.87**	10.00	......	.62	**.62**	......	**1.61**	......	25.64	21.50	943
.59	5.06	7.06	**12.71**	8.00	***5.65**	6.00	......	......	*	1.50	***.47**	.82	10.94	....	1373
														21.00	1204
.84	4.10	4.94	***9.88**	16.00	***4.94**	8.00	1.24	......	***1.24**	2.50	***.96**	1.65	17.14	25.00	1315

*Constituent falls below guarantee.
a Guaranty—Soluble, 7; insoluble, 1.
b Guaranty—Soluble, 7; insoluble, 1.

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COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
	SCHAAL-SHELDON FERTLIZER CO., ERIE, PA.		
1082	Farmers' Favorite,	G. R. Leslie, Edgecliff,	8.31
1126	Standard Phosphate,	C. C. Reese, Shugar Lake,	11.58
	THE SCOTT FERTILIZER CO., ELKTON, MD.		
1207	Standard Phosphate,	O. B. Peter, Bests,	10.20
926		J. C. Reber, Brook Park,	
1228		Kerschner Bros., Breningsville,	
1363		Sloyer Lenhart, Phoenixville,	
1187	Windsor Wheat Grower,	Farmers' Alliance, Windsor Castle,	9.27
	SHENANDOAH FERTILIZER CO., SHENANDOAH, PENNA.		
982	Shenandoah Brand,	A. Cameron Bobb, Paxinos,	5.77
1208	†Standard Potash Fertilizer,	O. B. Peter, Bests,	10.48
1310		Benj. B. Fox, Lyons,	
	M. L. SHOEMAKER CO., PHILADELPHIA, PA.		
1352	Good Enough Super-phosphate,	A. M. F. Stiteler, Byers Station,	11.43
1161	Special No. 2 Wheat Fertilizer,	Chester Co. Assn. of Farmers, Kelton,	10.06
1378	Swift Sure Guano for Fall Trade,	Henry A. Male, Pen Argyl,	9.35
	CHARLES A. SICKLER BRO., WILKES-BARRE, PA.		
989	†King Phosphate,	J. H. Kase, South Danville,	4.97
1002		W. F. Slagle, Bloomsburg,	
	SOUTHERN FERTILIZER CO., YORK, PA.		
1169	Export Bone and Potash,	Passmore & Gillespie, Nottingham,	5.43
1223	Gardeners' and Truckers' Delight,	J. S. Jobst, Emaus,	10.55
853	Ox Brand Queen of the Harvest,	Fletcher George, Lilly,	1090
1200	†Royal Wheat and Grass Grower,	Jessee Weaver, Mosierville,	9.30
872		Adam Berler, Millerstown,	
1222		J. B. Jobst, Emaus,	
1408		Passmore & Gillespie, Nottingham,	

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
5.49	3.89	2.87	**12.25**	c	**9.38**	c	2.33	......	**2.33**	2.00	**1.18**	1.15	23.79	20.00	1082
5.66	3.46	1.70	**10.82**	c	**9.12**	c	2.12	......	**2.12**	2.00	**1.66**	1.65	24.21	23.00	1126
4.59	4.61	3.82	**13.02**	10.00	**9.20**	8.00	2.48	......	**2.48**	2.00	**1.27**	1.24	24.07	20.00	1267
														20.00	926
														22.00	1228
														20.00	1363
6.79	5.24	2.37	**14.40**	......	**12.03**	......	4.10	......	**4.10**	......	**.77**	......	26.43	....	1187
4.66	3.77	1.56	**9.99**	b	**8.43**	b	3.51	......	***3.51**	15.50	***.86**	1.65	21.67	28.00	982
4.53	4.51	1.72	**10.76**	......	***9.04**	16.00	2.40	......	***2.40**	11.40	***.74**	1.24	20.86	23.00	1208
														23.00	1319
6.29	3.75	3.66	**13.70**	12.00	**10.04**	8.00	2.55	......	**2.55**	2.00	**1.66**	1.65	26.71	24.00	1352
7.67	4.04	3.79	**15.50**	......	**11.71**	......	1.20	......	**1.20**	......	**.71**	......	23.70	16.30	1161
.79	6.43	5.41	**12.63**	......	***7.22**	8.00	4.78	......	***4.78**	5.00	**1.71**	1.65	26.35	25.00	1378
2.21	3.56	1.72	**7.49**	a	**5.77**	a	2.50	......	**2.50**	2.00	***.53**	.82	16.39	19.00	989
														19.00	1002
1.60	2.62	10.02	**14.24**	......	**4.22**	......	2.36	......	**2.36**	......	**1.81**	......	23.30	23.00	1409
8.06	2.61	.96	***11.63**	13.30	***10.67**	12.00	6.23	......	**6.23**	6.00	**1.94**	1.65	31.24	30.00	1223
6.69	2.48	.92	***10.09**	11.50	***9.17**	10.00	2.20	......	**2.20**	2.00	***1.12**	1.24	22.04	24.00	853
6.07	2.33	.69	**9.09**	9.00	**8.40**	8.00	1.95	......	**1.95**	1.00	**.66**	.41	19.03	21.00	1200
														18.00	872
														19.00	1222
														18.00	1408

*Constituent falls below guarantee.
c Guaranty—Soluble, 8; insoluble, 1.
b Guaranty—Soluble, 8; insoluble, 1.
a Guaranty—Soluble, 8.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
	H. G. SUPPLEE, BLOOMSBURG, PA.		
1003	Grain and Grass Producer,	H. G. Supplee, Bloomsburg,	10.97
	SWIFT & CO., CHICAGO, ILLINOIS.		
1156	Pure Complete Fertilizer,	T. McConnell & Sons, Portersville,	7.05
	J. M. TEMPLIN, HONEYBROOK, PA.		
1285	Atlas Brand No. 4,	J. M. Templin, Honeybrook,	13.05
	JAMES THOMAS, WILLIAMSPORT, PA.		
1247	Klondyke,	James Thomas, Jersey Shore,	9.84
929	Klondyke Ammoniated Phosphate,	Wallborn & Danberman, Selinsgrove,	10.57
	I. P. THOMAS & SONS CO., PHILADELPHIA, PA.		
1367, 1290, 1383	†Farmers' Choice Bone Phosphate,	Linford Foulke, Quakertown, J. D. Zellers, Ephrata, Irwin L. Gan, Effort,	9.13
1405	Tip Top Raw Bone Super-phosphate,	Evan D. Jones & Co., Conshohocken,	7.73
	THE TUSCARORA FERTILIZER CO., PORT ROYAL, PENNA.		
868, 1095	†Pennsylvania Standard Phosphate,	D. B. Miller, Bellville, C. F. Stapleton, Saxton,	15.72
	I. J. TUSTIN, PHOENIXVILLE, PA.		
1362	Pickering Valley H. G. Phosphate,	Isaac J. Tustin, Phoenixville,	9.52
1361	Pickering Valley Special,	Isaac J. Tustin, Phoenixville,	9.30
	WALKER, STRATMAN & CO., PITTSBURG, PA.		
832	Fourfold,	Chas. Redd, Cowansville,	7.05
858, 847, 1086, 1130	†Grain King Fertilizer,	Kirsch & Lieb, Spangler, Chas. Yeackle, Eckenrode Mills, ——— Harmorville, Chas. Bovard, Board,	6.45
831	Meat, Blood and Bone,	Chas. Redd, Cowansville,	4.44
857	Welcome Brand Bone and Meat,	Kirsch & Lieb, Spangler,	4.65

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
5.25	3.76	1.36	**10.37**	......	**9.01**	......	4.75	......	**4.75**	......	**.74**	......	23.13	21.00	1603
4.62	5.52	4.17	**14.31**	11.00	**10.14**	8.00	1.11	......	**1.11**	1.00	**1.23**	1.03	23.84	24.00	1156
5.77	5.00	1.34	**12.11**	11.00	**10.77**	10.00	3.46	......	***3.46**	4.00	***1.39**	1.65	26.24	26.00	1285
6.50	2.94	.85	**10.29**	10.00	**9.44**	9.00	2.93	......	***2.93**	3.00	***.71**	.82	21.50	22.00	1247
6.66	3.04	.70	**10.40**	10.00	**9.70**	9.00	3.04	......	**3.04**	3.00	***.81**	.82	22.20	21.00	920
														30.50	1367
6.38	3.74	3.07	**13.19**	10.50	10.12	**9.50**	2.23	......	**2.23**	2.00	***1.64**	1.65	26.23	25.00	1290
														20.00	1383
3.80	3.90	5.19	**12.89**	10.00	***7.70**	8.00	3.33	.24	***3.57**	4.00	**2.56**	2.47	29.13	33.00	1405
														21.00	863
1.12	5.61	2.92	**9.65**	......	***6.73**	7.00	2.47	......	***2.47**	3.00	***.62**	.82	18.02	21.00	1095
4.89	2.93	2.59	**10.41**	a	**7.82**	a	3.35	......	**3.35**	3.00	***1.63**	2.06	24.42	25.00	1362
4.12	3.12	2.22	**9.46**	b	**7.21**	b	.93	.23	**1.16**	1.00	**.95**	.82	18.66	22.00	1361
5.15	3.06	4.45	**12.66**	9.00	**8.21**	8.00	2.42	......	**2.42**	2.00	**1.82**	1.65	25.38	17.00	832
														25.00	858
														22.00	847
6.75	2.91	2.05	**11.71**	10.00	**9.66**	9.00	4.98	......	**4.98**	4.00	**1.17**	.82	26.13	21.20	1086
														22.00	1130
6.06	2.98	3.34	**12.38**	10.00	**9.04**	8.00	1.33	8.60	**9.93**	8.00	***2.98**	3.30	39.73	28.00	831
.98	5.54	14.49	**21.01**	16.00	**6.52**	......	......	......	....	......	**3.33**	3.30	31.36	23.00	857

*Constituent falls below guarantee.
a Guaranty—Soluble, 8; insoluble, 2.
b Guaranty—Soluble, 7; insoluble, 1.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
	F. K. WALT CO., WAYNESBURG JUNCTION, PA.		
1216	Calcine Bone,	John Buchanan, Geigertown,	9.03
1317	XX Flesh and Animal Bone Phosphate,	James S. Heffner, Kutztown,	10.34
	JOHN WHANN & SON, PHILADELPHIA, PA.		
1332	J. W. & S. Special Mixture,	Atwood Criswell, Collamer,	12.19
863	Our Brand Raw Bone Phosphate,	Martin Dietrich, Lewistown,	11.39
1402	Reliable Ammoniated Super-phosphate,	Jones & Paxson, Hatboro,	11.93
1331	Wheat and Grass Mixture,	Atwood Criswell, Collamer,	13.45
	W. E. WHANN, SPRING MILLS, PA.		
1170	Chester Valley Special Ammoniated Super-phosphate,	John A. Rocky, Atglen,	7.55
	THE ROBERT A. WOOLRIDGE CO., BALTIMORE, MD.		
1289 1341	†Chieftain Bone Stock Phosphate,	E. O. Hacker, Ephrata, Franklin G. Evans, Kelton,	9.64
913	Chieftain Phosphate,	G. S. Gray, Scotia,	10.33
	YORK CHEMICAL CO., YORK, PA.		
1015	Dempwolf's Prosperity Fertilizer,	Dempwolf-Dillsburg,	12.24
1036	Dempwolf's Special Oats Fertilizer,	A. K. Straley,	10.62
	HENRY S. ZOOK ELVERSON, PA.		
1396	No. 6 Pride of Chester Dissolved Animal Bone Phosphate.	Joseph Jackson, Joanna,	11.95

For explanation of these tables see p. 792. †Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
4.26	5.31	5.40	**15.00**	......	**9.60**	......	1.97	......	**1.97**	.....	**.71**	......	22.56	20.00	1216
2.79	4.94	4.98	**12.71**	......	**7.73**	......	3.00	......	**3.00**	......	**.82**	......	21.62	24.00	1317
6.53	1.46	1.32	**9.31**	......	**7.99**	7.00	4.69	......	***1.69**	[illegible]	***1.02**	1.44	23.10	24.00	1332
7.66	1.92	1.76	**11.34**	......	**9.58**	9.00	2.31	......	***2.31**	2.50	***1.56**	1.85	24.84	....	963
7.40	1.81	.99	**10.20**	......	**9.21**	8.00	1.83	......	***1.83**	2.00	***1.32**	1.65	[illegible]	[illegible]	[illegible]
7.48	1.69	.88	**10.05**	......	**9.17**	8.00	1.95	......	***1.95**	2.00	***1.04**	1.24	21.67	22.00	1331
3.34	4.84	1.17	**9.35**	......	**8.18**	7.50	2.89	......	**2.89**	2.00	***.73**	.82	[illegible]	20.00	1170
5.42	3.12	1.16	**9.70**	......	***8.54**	9.00	2.53	......	**2.53**	2.00	***1.63**	1.65	[illegible]	22.00	1280
														......	1341
4.29	4.43	2.98	**11.70**	......	***8.72**	9.00	2.38	......	**2.38**	2.00	**1.83**	1.65	25.30	21.50	913
5.04	3.98	.83	**9.85**	......	**9.02**	......	3.14	......	**3.14**	......	**.66**	......	20.88	....	1115
4.26	2.66	.54	**7.46**	......	**6.92**	......	4.00	.69	**4.69**	.....	**2.15**	......	25.81	23.00	1606
3.75	4.20	1.64	**9.59**	a	**7.95**	a	2.56	......	***2.56**	3.00	***.59**	1.24	19.14	23.75	[illegible]

*Constituent falls below guarantee.
a Guaranty—Soluble, 8.

ROCK AND POTASH

Furnishing Phosphoric

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	ALLEGHENY CITY FERTILIZER WORKS, ALLEGHENY, PA.	
829	Dissolved Bone and Potash,	Wm. Snyder, Cowansville,
	THE ALLENTOWN MANUFACTURING CO., ALLENTOWN, PA.	
1392	Phosphate and Potash,	David T. Barnett, Bethlehem,
	THE AMERICAN AGRICULTURAL CHEMICAL CO., NEW YORK.	
	CANTON-CHEMICAL BRANCH, BALTIMORE, MD.	
875	Canton-Chemical Soluble Alkaline Bone,	George W. Vurd, Mansville,
	CLARK'S COVE BRANCH, NEW YORK.	
937	†Clark's Cove Triumph Bone and Potash,	C. J. Bushey, Dillsburg,
1063		John Nealer, Indiana,
	MARYLAND BRANCH, BALTIMORE, MD.	
1033	Maryland Alkaline Bone,	J. B. Zimmerman,
	MORO-PHILIPS BRANCH, PHILADELPHIA, PA.	
1292	†Moro-Philips Alkaline Bone Phosphate,	J. E. Bouse, Clement Station,
1379		William Hoodmaker, Wind Gap,
932	†Moro-Philips Wheat Special,	J. E. Bouse, Selinsgrove,
861		Ewing & Kinsloe, Newton Hamilton,
1047		Ellis Eves & Bro., Millville,
1224		W. H. H. Meckey, Alburtis,
	NIAGARA BRANCH, BUFFALO, N. Y.	
1252	Niagara Dissolved Bone Potash 10x2,	G. D. Glossner, Jacksonville,
	PACKER'S UNION BRANCH-RUTLAND, VERMONT,	
881	Packer's Union Wheat and Clover,	H. M. Hass, Sunbury,
	READ BRANCH, SYRACUSE, N. Y.	
1324	Read's Bone and Potash,	George Hess, Nazareth,

For explanation of these tables see p. 792. †Composite sample.

FERTILIZERS.

Acid and Potash.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds. Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash in 100 Pounds. Present as muriate.	Present as sulphate.	Total. Found.	Total. Guaranteed.	Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
8.23	5.46	4.98	2.14	**12.58**	11.00	**10.44**	10.00	1.99	....	***1.99**	2.00	14.14	18.00	829
9.58	9.89	4.48	.85	**15.22**	14.00	**14.37**	13.00	2.10	....	**2.10**	2.00	16.66	21.00	1[illegible]2
11.45	10.43	3.54	.65	**14.62**	13.00	**13.97**	12.00	2.64	....	**2.64**	....	16.96	16.00	[illegible]
10.87	8.49	3.45	1.00	**12.94**	11.00	**11.94**	10.00	2.29	....	**2.29**	[illegible]	[illegible]	14.75 15.[illegible]	917 1[illegible]
11.84	9.41	3.29	.32	**13.02**	13.00	**12.70**	12.00	2.83	....	***2.83**	3.00	16.16	17.00	1033
9.91	5.83	5.25	1.19	**12.27**	11.00	**11.08**	10.00	2.09	....	**2.09**	2.00	14.31	14.[illegible] 14.[illegible]	1[illegible] 137[illegible]
10.23	7.29	3.74	1.09	**12.12**	11.00	**11.03**	10.00	2.17	....	**2.17**	[illegible]	14.49	1[illegible] 15.75 17.[illegible] 19.[illegible]	[illegible] 861 1[illegible]7 1224
10.34	7.84	3.40	.34	***11.58**	15.00	***11.24**	14.00	2.02	....	**2.02**	....	14.26	14.00	1252
11.33	6.09	5.17	1.14	**12.40**	9.00	**11.26**	8.00	2.17	....	**2.17**	2.00	14.50	15.[illegible]	881
10.63	3.46	5.98	2.10	**11.54**	11.00	***9.44**	10.00	2.16	....	**2.16**	2.00	13.44	18.00	1324

*Constituent falls below guarantee.

ROCK AND POTASH

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	REESE BRANCH, BALTIMORE, MD.	
972	Reese's Grass and Grain,	B. F. Stine, Red Line,
	ZELL BRANCH, BALTIMORE, MD.	
1054	†Zell's Electric Phosphate,	John Campbell Heshbon, Davidsville,
1037		R. C. Hetfley, Berlin,
1136		E. A. Watson, Isles,
	THE ARMOUR FERTILIZER WORKS, CHICAGO, ILL.	
1411	Phosphate and Potash No. 1,	Passmore & Gillespie, Nottingham,
	BALTIMORE PULVERIZING CO., BALTIMORE, MD.	
860	†Special Fall Mixture,	Jesse Williams, Utahville,
940		D. E. Brown, East Berlin,
894	Special Spring and Fall Mixture,	Steininger Bros., Middleburg,
	BOWKER FERTILIZER CO., BOSTON, MASS.	
1192	†Super-phosphate with Potash,	M. C. Dietrich, Kempton,
906		S. L. Strohacher, Rebersburg,
1221		William M. Gehman, Macungie,
1272		William Wiedensaul,
	E. FRANK COE CO., NEW YORK.	
950	†Special Dissolved Bone and Potash Brand,	D. E. Brown, East Berlin,
1004		H. B. Lowe, Orangeville,
	J. A. CRANSTON, NEWPORT, DEL.	
1267	Horse Shoe Soluble Bone and Potash,	H. F. Dungan,
	THE FARMERS' FERTILIZER CO., WESTMINSTER, MD.	
[illegible]	F. A. & P. Phosphate,	Isaiah Diller,
	S. M. HESS & BRO., PHILADELPHIA, PA.	
1030	†Emperor Phosphate,	H. L. Brubaker, Mechanicsburg,
1050		Jacob Kauffman, Jr., Johnstown,
889	Soluble Bone and Potash,	E. M. Klingler, Vicksburg,

For explanation of these tables see p. 792. †Composite sample.

FERTILIZERS—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds. Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash in 100 Pounds. Present as muriate.	Present as sulphate.	Total. Found.	Total. Guaranteed.	Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
10.01	5.77	5.20	.79	**11.76**	11.00	**10.97**	10.00	2.12	....	**2.12**	2.00	14.10	16.00	972
10.40	6.73	4.12	.89	**11.74**	11.00	**10.85**	10.00	2.52	....	**2.52**	2.00	14.60	...... 16.50 19.00	1054 1037 1136
9.92	5.03	6.19	1.53	**12.75**	12.00	**11.22**	10.00	2.32	....	**2.32**	2.00	14.65	13.50	1411
7.34	1.61	6.90	1.08	**9.59**	....	**8.51**	8.00	1.26	....	***1.26**	2.00	11.36	16.00 15.00	860 949
6.53	1.29	7.23	1.25	**9.77**	....	**8.52**	8.00	1.50	....	***1.50**	2.00	11.65	15.00	894
11.45	4.59	6.14	2.68	**13.41**	....	**10.73**	10.00	.88	....	***.88**	1.00	13.29	17.00 19.00 19.00 15.00	1192 996 1221 1272
1293	6.18	3.92	2.79	**12.89**	12.00	**10.10**	10.00	1.99	....	***1.99**	2.00	14.25	15.00 14.00	950 1004
11.99	4.87	5.24	2.69	**12.80**	12.00	**10.11**	10.00	1.98	....	***1.98**	2.00	14.06	15.00	1267
12.34	9.30	3.30	.37	**12.97**	....	**12.60**	11.00	3.08	....	**3.08**	3.00	16.38	....	960
10.75	5.32	4.51	.33	**10.16**	11.00	***9.83**	10.00	1.21	....	**1.21**	1.00	12.27	16.00 20.00	1030 1050
11.50	6.75	3.13	1.90	**11.78**	11.00	***9.88**	10.00	2.08	....	**2.08**	2.00	15.19	15.00	889

*Constituent falls below guarantee.

ROCK AND POTASH

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	THE HUBBARD FERTILIZER CO., BALTIMORE, MD.	
984	†Soluble Bone and Potash,	A. Cameron Bobb, Paxinos,
897		B. F. Keiser & W. G. Kline, Lewisburg,
901		Bothner & Dietz, Danville,
	LANCASTER CHEMICAL CO., LANCASTER, PA.	
1294	No. 10 Economist Fertilizer,	Monroe Gingerich, P. & R. Freight Yards,
	LISTER'S AGRICULTURAL CHEMICAL WORKS, NEWARK, N. J.	
1079	†Animal Bone and Potash,	G. W. Martin & Co., Saltsburg,
1284		George Bard, Mechanicsburg,
	MILLER FERTILIZER CO., BALTIMORE, MD.	
1327	Clinch Phosphate,	M. T. Harkins, Hickory Hill,
947	Clinch Phosphate, Rock and Potash,	Henry Linebaugh, East Berlin,
	WILLIAM C. NEWPORT CO., WILLOW GROVE, PA.	
1005	†Soluble Bone and Potash,	H. B. Lowe, Orangeville,
935		Cook Deardorff Co., Dillsburg,
1045		H. F. Seip, Somerset,
1356		Dewees & Bracken, Paoli,
	PATAPSCO GUANO CO., BALTIMORE, MD.	
1209	H. G. Bone and Potash,	Elias Wotring Sons, Germansville,
1140	Soluble Bone and Potash,	M. T. McCandless, Prospect, Pa.,
	J. D. PERKINS, COATESVILLE, PA.	
1348	Globe Phosphate,	J. D. Perkins, Coatesville,
	PIEDMONT-MT. AIRY GUANO CO., BALTIMORE, MD.	
1313	Levering's IXL,	Kachel & Griffith, Joanna,
[illegible]	†Levering's IXL Crop Grower,	Walker Bros., Glade,
957		H. H. Loose, Abbottstown,
1240		J. G. Simpson, Huntingdon,
955	Soluble Bone and Potash for Grain and Grass,	H. H. Loose, Abbottstown,

For explanation of these tables see p. 792. †Composite sample.

FERTILIZERS—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds. Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash in 100 Pounds. Present as muriate.	Present as sulphate.	Total. Found.	Total. Guaranteed.	Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
13.03	4.04	5.19	2.73	**11.96**	....	**9.23**	....	2.42	....	**2.42**	2.00	13.86	16.00 14.50 18.00	984 897 991
12.39	4.26	6.32	1.48	**12.06**	11.00	**10.58**	10.00	2.28	....	**2.28**	2.00	14.13	15.00	1291
8.76	6.26	3.32	1.76	**11.34**	....	**9.58**	....	4.69	....	**4.69**	....	16.35	20.00 0.00	1079 12.84
9.71	5.69	5.54	1.28	**12.51**	11.50	**11.23**	10.00	1.86	....	***1.86**	2.00	14.18	16.00	1327
9.07	4.92	6.10	.43	***11.45**	11.50	**11.02**	10.00	1.95	....	***1.95**	2.00	13.75	15.00	947
13.55	2.82	5.66	2.12	**10.60**	9.00	**8.48**	8.00	1.72	....	***1.72**	3.00	12.34	14.00 15.00 15.00 15.00	1005 935 1045 1356
12.47	8.79	2.71	.24	***11.74**	12.00	**11.50**	11.00	4.82	....	***4.82**	5.00	17.35	18.00	1209
12.79	8.04	3.72	.33	**12.09**	11.00	**11.76**	10.00	1.82	....	***1.82**	2.00	14.38	16.00	1140
10.69	3.79	5.76	2.25	**11.80**	....	***9.55**	11.00	2.20	....	**2.20**	2.00	13.65	....	1348
10.56	1.43	8.34	2.31	**12.08**	....	***9.77**	10.00	2.95	....	***2.95**	3.00	14.30	16.00	1313
10.53	3.94	5.76	.67	**10.37**	....	***9.70**	10.00	3.68	....	**3.68**	3.00	14.72	15.00 17.50 17.50	1093 957 1240
10.45	3.25	7.32	1.61	**12.18**	....	**10.57**	8.00	2.40	....	**2.40**	2.00	14.18	15.00	955

*Constituent falls below guarantee.

ROCK AND POTASH

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	RAMSBURG FERTILIZER CO., FREDERICK, MD.	
966	Alkaline Phosphate,	Duttera & Easley, Hanover,
	RASIN MONUMENTAL CO., BALTIMORE, MD.	
1013	Soluble Bone Phosphate and Potash,	H. M. Sunday, York,
	SHENANDOAH FERTILIZER CO., SHENANDOAH, PA.	
1309	Special Wheat Grower,	Benj. B. Fox, Lyons,
	SOUTHERN FERTILIZER CO., YORK, PA.	
1097	†Ox Brand Bone and Potash,	H. Frank Gump, Everett,
1194		M. C. Dietrich, Kempton,
979	†Soluble Bone and Potash,	F. Z. Stauffer, York,
981		A. Cameron Bobb, Paxinos,
	I. P. THOMAS & SONS CO., PHILADELPHIA.	
1012	†Alkaline Bone,	C. R. Henry, Millville,
1178		Thomas Taylor, Russelville,
1280		Hamiton Hinkel, Dover,
965		John M. Yoder, Bellville,
1325		Austin Krause, Nazareth,
1366		Linford Foulk, Quakertown,
1384		Irwin L. Gann, Effort,
	TUSCARORA FERTILIZER CO., PORT ROYAL, PA.	
866	†Bone and Potash,	D. B. Miller, Bellville,
864		M. P. Yoder, Bellville,
1094		C. F. Stapleton, Saxton,
	WALKER STRATMAN & CO., PITTSBURG, PA.	
855	†Welcome Brand Phosphoric Acid and Potash,	Kirsch & Liet, Spangler,
[illegible]		J. C. Kelly, Prospect,
	W. E. WHANN, SPRING MILLS, PA.	
1021	Soluble Bone and Potash,	Frank Stokes, New Kingston,
1167		John A. Rockey, Atglen,

For explanation of these tables see p. 792. †Composite sample.

FERTILIZERS—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.				Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
	Soluble in water.	Reverted.	Insoluble.	Total.		Available.		Present as muriate.	Present as sulphate.	Total.				
				Found.	Guaranteed.	Found.	Guaranteed.			Found.	Guaranteed.			
10.93	1.20	9.59	2.12	**12.91**	12.00	**10.79**	10.00	2.49	....	**2.49**	2.00	14.34	14.00	906
20.83	3.09	6.74	2.81	**12.64**	11.00	***9.83**	10.00	1.47	....	***1.47**	2.00	13.17	15.00	1013
10.55	2.26	6.25	2.17	**10.68**	....	**8.51**	....	1.29	....	***1.29**	5.70	11.90	18.00	1309
10.20	8.19	3.66	1.52	**13.37**	12.00	**11.85**	11.00	1.81	....	***1.81**	2.00	14.88	17.00	1097
													15.00	1194
11.93	7.34	4.19	.54	**12.07**	....	**11.53**	....	2.07	....	**2.07**	....	14.48	16.00	979
													16.00	981
13.27	4.20	6.12	2.09	**12.41**	12.00	**10.32**	10.00	2.33	....	**2.33**	2.00	14.24	15.00	1012
													14.00	1178
													15.00	1286
													21.00	865
													14.00	1325
													20.50	1366
													18.00	1354
8.29	.51	7.03	3.92	**11.46**	8.00	**7.54**	7.00	2.34	....	**2.34**	1.00	12.80	14.25	866
													14.00	864
													14.50	1094
11.35	5.81	4.56	2.50	**12.87**	11.00	**10.37**	10.00	2.11	....	**2.11**	2.00	14.36	16.00	855
													15.00	1139
7.83	3.32	6.99	1.01	**11.32**	....	**10.31**	10.00	2.58	....	**2.58**	2.00	13.99	......	1031
													15.25	1167

*Constituent falls below guarantee.

ACIDULATED ROCK

Furnishing

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	ALLEGHENY CITY FERTILIZER WORKS, ALLEGHENY CITY, PA.	
1087	Full Value Phosphate,	L. & F. Hoburg, Sharpsburg,
	THE AMERICAN AGRICULTURAL CHEMICAL CO., NEW YORK. CLARK'S COVE BRANCH, NEW YORK.	
908	†Clark's Cove Atlas,	Jacob Shearer, Centre Hall,
940		C. J. Bushey,
1118	Clark's Cove Atlas Bone Phosphate,	Fowler Ellis, Franklindale,
	MARYLAND BRANCH, BALTIMORE, MD.	
862	†Maryland Dissolved S. C. Bone,	Ewing & Kinsloe, Newton Hamilton,
968		Seffer & Frey, Hanover,
841	Maryland I. C. Bone,	W. A. Nicodemus, Curry,
	MICHIGAN CARBON WORKS BRANCH, DETROIT, MICH.	
1059	Michigan Red Line Phosphate,	J. S. Orr, Indiana,
	NIAGARA BRANCH, BUFFALO, N. Y.	
1255	Niagara Dissolved Bone Phosphate 14 per cent.,	C. D. Glosner, Jacksonville,
	QUINNIPIAC BRANCH, NEW YORK.	
1376	†Quinnipiac Soluble Dissolved Bone,	James Kostenbader, Wind Gap,
1061		J. S. Culp, Indiana,
1377		E. J. Houck, Bangor,
	REESE BRANCH, BALTIMORE, MD.	
942	Reese's Elm Phosphate,	N. H. Spangler, Rossville,
	SUSQUEHANNA BRANCH, BALTIMORE, MD.	
953	†Susquehanna Soluble Bone Phosphate,	Henry Berkeimer, Abbottstown,
1101		Wm. Shaw, Manns Choice,
924		Wm. A. Ishler, Bellefonte,
1185		Solomon H. Lenhart, Hamburg,
1305		Wm. F. Fenechel, Bethlehem,

For explanation of these tables see p. 792. †Composite sample.

PHOSPHATES.

Phosphoric Acid.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
	Soluble in water.	Reverted.	Insoluble.	Total.		Available.				
				Found.	Guaranteed.	Found.	Guaranteed.			
5.53	4.66	7.07	2.77	**14.50**	13.00	***11.73**	12.00	11.80	15.00	1087
									13.50	908
9.76	11.72	3.83	1.03	**16.58**	15.00	**15.55**	14.00	14.32	12.50	940
6.85	11.05	5.51	.64	**17.20**	15.00	**16.56**	14.00	14.70	16.00	1118
									13.15	862
9.31	11.52	4.19	93	**16.64**	15.00	**15.71**	14.00	14.35	13.00	968
9.61	10.82	5.16	.36	**16.34**	15.00	**15.98**	14.00	14.24	14.00	844
11.90	11.43	4.12	2.31	**17.86**	15.00	**15.55**	14.00	14.73	15.00	1059
8.46	9.65	5.66	.87	**16.18**	15.00	**15.31**	14.00	13.87	12.50	1255
									12.50	1376
10.23	11.13	4.62	.82	**16.57**	15.00	**15.75**	14.00	14.28	14.00	1061
									13.00	1377
7.40	9.70	4.98	1.49	**16.17**	15.00	**14.68**	14.00	13.70	12.50	942
									13.00	953
									13.50	1101
10.25	11.54	3.73	1.27	**16.54**	15.00	**15.27**	14.00	14.23	13.00	924
									14.00	1185
									17.00	1305

*Constituent falls below guarantee.

ACIDULATED ROCK

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
1334	Susquehanna Superior Rock Phosphate,	George B. Passmore Sons, Oxford,
	WILLIAMS & CLARK BRANCH, NEW YORK.	
868	Williams & Clark's Acorn Brand,	C. W. Jones, Titusville,
	BERGER BROS., EASTON, PA.	
1326	H. G. Acid Phosphate,	Frank T. Gennett, Nazareth,
	D. BLOCHER & CO., GETTYSBURG, PA.	
1100	Dissolved Bone Phosphate,	John S. Hershberger, Everett,
	S. B. BRODBECK, BRODBECK'S, PA.	
969	Ruth Dissolved Bone Phosphate,	Sheffer & Frey, Hanover
	E. FRANK COE CO., NEW YORK.	
970	†H. G. Soluble Bone,	G. E. Sprenkel, Nashville,
1380		Wm. Mengel, Taylorsburg,
1382	XXX Acid Phosphate,	Wm. Mengel, Snyderville,
	J. A. CRANSTON CO., NEWPORT, DEL.	
1266	Horse Shoe Soluble Bone, Phosphate,	H. F. Dungan,
	JAMES G. DOWNWARD & CO., COATESVILLE, PA.	
1343	H. G. Acid Phosphate,	Harry LeFevre, Chatham,
	FARMERS' FERTILIZER CO., WESTMINSTER, MD.	
961	Acid Phosphate,	Isaiah Diller,
	CHAS. V. GEIGER, GEIGER'S MILLS, PA.	
1398	H. G. Acid Phosphate,	Chas. V. Geiger, Geigertown,
	W. S. HASTINGS & SON, ATGLEN, PA.	
1171	Clear Acid Phosphate,	Wm. S. Hastings & Son, Atglen,
	THE HUBBARD FERTILIZER CO., BALTIMORE, MD.	
[illegible]	Crescent Soluble Crop Producer,	A. Cameron Bobb, Paxinos,
[illegible]	†H. G. Soluble Tennessee Phosphate,	H. B. Low, Orangeville,
[illegible]		Hervey Smith,
	M. P. HUBBARD & CO., BALTIMORE, MD.	
[illegible]	H. G. Soluble S. C. Phosphate,	W. P. Dixon, Livermore,

For explanation of these tables see p. 792. †Composite sample.

PHOSPHATES—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
	Soluble in water.	Reverted.	Insoluble.	Total.		Available.				
				Found.	Guaranteed.	Found.	Guaranteed.			
9.64	12.95	3.23	.67	**16.85**	15.00	**16.18**	14.00	14.72	12.00	1334
2.10	10.48	5.73	1.27	**17.48**	15.00	**16.21**	14.00	14.67	14.00	838
11.81	10.93	4.50	.59	**16.02**	14.00	**15.43**	13.00	13.96	13.00	1326
11.24	13.44	3.26	.16	**16.86**	....	**16.70**	....	14.90	14.00	1100
12.43	11.66	4.47	.19	**16.32**	....	**16.13**	14.00	14.34	13.00	969
11.64	9.20	4.78	2.06	**16.04**	16.00	***13.98**	14.00	13.45	12.00	970
									13.50	1380
10.00	8.48	4.96	3.09	**16.53**	14.00	**13.44**	12.00	13.41	13.00	1382
10.13	9.07	5.37	2.92	**17.36**	16.00	**14.44**	14.00	14.01	15.00	1266
9.87	6.79	8.56	.98	**16.33**	15.00	**15.35**	14.00	13.59	12.00	1343
7.59	9.03	6.13	.51	**15.67**	....	**15.16**	14.00	13.56	12.00	967
10.66	11.74	3.45	2.28	**17.47**	....	**15.19**	....	14.55	....	1398
10.38	12.82	3.66	.55	**17.03**	....	**16.48**	14.00	14.85	12.00	1171
3.26	4.44	5.82	6.03	**16.29**	....	**10.26**	....	12.07	12.00	985
6.95	9.14	4.69	5.61	**19.44**	....	***13.83**	14.00	14.62	13.00	1006
									12.00	1268
10.29	11.38	4.62	.34	**16.34**	....	**16.00**	14.00	14.30	13.50	1075

*Constituent falls below guarantee.

ACIDULATED ROCK

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	JARECKI CHEMICAL CO., SANDUSKY, OHIO.	
1131	C. O. D. Phosphate,	G. A. Blair, Wesley,
	LANCASTER CHEMICAL CO., LANCASTER, PA.	
1293	Acid Phosphate,	John E. Engle,
	McCALMANT & CO., BELLEFONTE, PA.	
918	H. G. Florida Bone,	McCalmont & Co., Bellefonte,
	MILLER FERTILIZER CO., BALTIMORE, MD.	
946	†S. C. Rock,	Henry Linebaugh, East Berlin,
1328		M. T. Harkins, Hickory Hill,
	OHIO FARMERS' FERTILIZER CO., COLUMBUS, O.	
1110	Acid Phosphate,	Thos. Lloyd, Brisbin,
	J. D. PERKINS, COATESVILLE, PA.	
1404	Acidulated Phosphate,	E. B. Hickman & Sons, West Chester,
	PIEDMONT-MT. AIRY GUANO CO., BALTIMORE, MD.	
954	Diamond S. Soluble Bone,	H. H. Loose, Abbottstown,
1250	†H. G. South Carolina Bone,	Col. J. A. Woodward, Howard,
956		H. H. Loose, Abbottstown,
1314		Kachel & Griffith, Joanna,
1239	Levering's Dissolved Bone Phosphate,	J. G. Simpson, Huntingdon,
	PITTSBURG PROVISION CO., PITTSBURG, PA.	
1056	Acid Phosphate,	J. W. Botsford, Marion Centre,
	W. S. POWELL & CO., BALTIMORE, MD.	
848	Dissolved S. C. Bone,	A. F. Stutzman, Johnstown,
	RAMSBURG FERTILIZER CO., FREDERICK, MD.	
964	Dissolved Bone Super-phosphate,	Duttera & Easley, Hanover,
	M. L. SHOEMAKER & CO., PHILADELPHIA, PA.	
1162	Dissolved S. C. Rock,	Chester Co. Assn. of Farmers, Kelton,
1163	Dissolved S. C. Rock 16 per cent.,	Chester Co. Assn. of Farmers, Kelton,
	E. A. SLAGLE, PAXINOS, PA.	
998	Dissolved Bone,	W. F. Slagle, Bloomsburg,

For explanation of these tables see p. 792. †Composite sample.

PHOSPHATES—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds. Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
13.88	10.24	5.01	1.30	**16.55**	15.00	**15.25**	14.00	14.05	[illegible]	1134
15.52	13.27	3.42	.61	**17.30**	15.00	**16.69**	14.00	15.08	12.50	1263
11.30	10.18	5.03	.73	***15.94**	16.00	**15.21**	14.00	13.88	13.00	918
8.03	10.47	4.95	.82	**16.24**	15.50	**15.42**	14.00	14.02	13.00	946
									12.00	1328
3.23	2.19	6.39	2.69	**11.27**	10.00	***8.58**	9.00	9.58	15.00	1110
8.08	7.11	8.10	1.01	**16.22**	....	**15.21**	14.00	13.53	13.00	1404
11.40	11.92	2.38	.25	**14.55**	12.00	**14.30**	10.00	13.30	12.50	954
									11.80	1250
10.79	12.05	2.98	.64	**15.67**	....	**15.03**	14.00	13.89	13.50	956
									12.50	1314
7.50	5.86	7.03	3.23	**16.12**	....	**12.89**	....	12.80	14.50	1239
2.98	.70	10.57	3.55	**14.82**	14.00	***11.27**	13.00	11.32	14.00	1056
10.76	12.97	2.58	.40	***15.95**	16.00	**15.55**	14.00	14.23	13.00	848
10.76	9.70	4.13	3.78	**17.61**	16.00	***13.83**	14.00	14.04	12.50	964
11.54	12.47	2.79	.32	**15.58**	14.00	**15.26**	12.00	13.99	10.30	1162
9.80	14.25	3.18	.44	**17.87**	14.00	**17.43**	12.00	15.52	11.30	1163
10.15	12.71	3.56	.40	**16.67**	....	**16.27**	14.00	14.62	13.00	998

*Constituent falls below guarantee.

ACIDULATED ROCK

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	I. P. THOMAS & SONS, PHILADELPHIA, PA.	
1014	†Dissolved Phosphate,	Hamilton Hinkel, Dover,
1096		H. Frank Gump, Everett,
1190	†S. C. Phosphate,	Levi Miller, Sinking Springs,
1011		C. R. Henry, Millville,
1365		John W. Root, Kimberton,
1375		Austin Knause, Nazareth,
	TUSCARORA FERTILIZER CO., PORT ROYAL, PA.	
915	†Tuscarora Acid Phosphate,	E. Musser, State College,
867		D. B. Miller, Bellville,
1098		W. W. McDaniel, Everett,
	J. E. TYGERT & CO., PHILADELPHIA, PA.	
1183	Acid Phosphate,	D. S. Potteiger, Hamburg,
	WALKER, STRATMAN & CO., PITTSBURG, PA.	
816	Welcome Brand Help Mate Fertilizer,	Chas. Yeackle, Eckenrode Mills,
	F. K. WALT, WAYNESBURG JUNCTION.	
1215	†A. A. Acid Phosphate,	John Buchanan, Geigertown,
1318		Jas. S. Heffner, Kutztown,
	JOHN WHANN & SON, PHILADELPHIA, PA.	
[illegible]	A. A. Acid Phosphate,	Atwood Criswell, Collamer, Pa.,
	W. E. WHANN, SPRING MILLS.	
1168	S. C. Phosphate,	John A. Rockey, Atglen,
	THE R. A. WOOLRIDGE CO., BALTIMORE, MD.	
914	†Florida Acid Phosphate,	G. S. Gray, Scotia,
882		Jos. Gass, Jr., Sunbury,
1251		Chas. Lee, Howards, Pa.,

For explanation of these tables see p. 792. †Composite sample.

PHOSPHATES—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds. Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
5.40	3.00	7.06	3.62	**13.68**	11.00	**10.06**	10.00	10.92	12.00	[illegible]
									13.00	[illegible]
10.77	11.51	3.66	1.72	**16.89**	16.00	**15.17**	14.00	14.31	13.50	[illegible]
									13.00	1611
									12.50	[illegible]
									12.00	1375
9.39	6.25	6.28	5.06	**17.59**	....	***12.53**	14.00	13.30	......	915
									14.00	867
									14.00	[illegible]
12.80	12.24	3.80	.27	**16.31**	....	**16.04**	....	14.40	14.00	1183
7.53	7.04	6.85	1.01	**14.90**	13.00	**13.89**	12.00	12.75	14.00	846
9.64	8.28	5.53	6.82	**20.63**	....	**13.81**	....	14.96	12.00	1215
									13.00	1318
13.47	12.21	2.12	.79	**15.12**	....	**14.33**	14.00	13.53	12.50	1330
10.73	9.63	7.80	.59	**18.02**	....	**17.43**	14.00	15.01	11.50	1168
10.55	10.03	4.80	1.19	**16.02**	....	**14.83**	14.00	13.71	13.50	914
									13.[illegible]	882
									......	1251

*Constituent falls below guarantee.

DISSOLVED BONE

Furnishing Phosphoric

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	EUREKA FERTILIZER CO., PERRYVILLE, MD.	
1414	Pure Dissolved Bone,	Lewis H. Kirk & Co., Nottingham,
	LISTERS AGRICULTURAL CHEMICAL WORKS, NEWARK, N. J.	
1358	Celebrated Ground Bone Acidulated,	Wm. H. Fritz, Berwyn,
	READING CHEMICAL AND FERTILIZER CO., LTD., READING, PA.	
1227	†A. A. Brand Fertilizer,	R. D. Butz, Shannock,
1217		John Wolf, Geigertown,
1399		Harry C. Moyer, Blooming Glen,
	SWIFT & CO., CHICAGO, ILL.	
1286	Ammoniated Bone,	Eli M. Martin, New Holland,
	JOHN WHANN & SON, PHILADELPHIA, PA.	
1172		P. M. Lantz, Nine Points,

For explanation of these tables see p. 792. †Composite sample.

FERTILIZERS.

Acid and Nitrogen.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
	Soluble in water.	Reverted.	Insoluble.	Total.		Available.						
				Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
9.71	7.78	4.25	4.58	**16.61**	....	**12.03**	....	**1.26**	....	24.14	22.00	1414
4.29	1.33	4.94	8.71	**14.98**	12.00	**6.27**	....	**3.51**	2.68	27.79	27.50	1358
											22.00	1227
6.13	.55	5.15	8.05	**13.75**	8.50	***5.70**	6.00	***.39**	1.24	11.13	20.00	1217
											25.00	1399
3.92	.21	6.10	13.66	**19.97**	16.00	**6.31**	....	***3.61**	4.74	30.40	27.00	1286
5.44	.68	6.84	14.09	**21.61**	....	**7.52**	....	**3.50**	....	32.79	....	1172

*Constituent falls below guarantee.

GROUND BONE

Furnishing Phosphoric

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	THE AMERICAN AGRICULTURAL CHEMICAL CO., NEW YORK.	
852, 1064	†Bone Meal,	H. G. Hubert, Salix; John Nealer, Indiana,
	BRADLEY BRANCH, BOSTON, MASS.	
1089	Abattoir Bone Dust,	S. J. Saint, Sharpsburg,
	CANTON CHEMICAL BRANCH, BALTIMORE, MD.	
1360	Canton Chemical Fine Ground Bone,	George H. Jacobs, Devault,
	CLARKS COVE BRANCH, NEW YORK.	
1116	Clark's Cove Sunflower Bone Meal,	Fowler Ellis, Franklindale,
	CROCKER BRANCH, BUFFALO, N. Y.	
841	Crocker's Ground Bone,	H. C. Mapes, Pleasantville,
	DETRICK BRANCH, BALTIMORE, MD.	
1149	Detrick's Bone Meal,	George Dindinger, Harmony,
	MILSOM BRANCH, EAST BUFFALO, N. Y.	
1125	Milsom's Fine Ground Bone,	Walter B. Denny, Meadville,
	QUINNIPIAC BRANCH, NEW YORK.	
1090	Quinnipiac Bone Meal,	S. J. Saint, Sharpsburg,
[illegible]	Quinnipiac Uncas Bone Meal,	S. J. Saint, Sharpsburg,
	SUSQUEHANNA BRANCH, BALTIMORE, MD.	
849, [illegible]	†Susquehanna Pure Ground Bone,	C. Neis, Geistown; Geo. B. Passmore Sons, Oxford,
[illegible]	Susquehanna Pure Ground Bone,	Geo. B. Passmore Sons, Oxford,
	WILLIAMS & CLARK BRANCH, NEW YORK.	
[illegible]	Williams & Clark's Carteret Ground Bone,	O. W. Jones, Titusville,
	HENRY COPE & CO., LINCOLN UNIVERSITY, PA.	
1165	Ground Raw Bone,	Henry Cope & Co., Oxford,
	JOSIAH COPE & CO., LINCOLN UNIVERSITY, PA.	
1044	Ground Raw Bone,	Joseph M. Miller, Bills,

For explanation of these tables see p. 792. †Composite sample.

FERTILIZERS.

Acid and Nitrogen.

Moisture in 100 pounds.	Mechanical Analysis.		Chemical Analyses.				Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
	Diameter less than 1-50 inch, "fine."	Diameter greater than 1-50 inch, "coarse."	Phosphoric Acid.		Nitrogen.				
			Found.	Guaranteed.	Found.	Guaranteed.			
6.50	77	23	**16.66**	13.68	**1.96**	1.65	21.20	24.00 26.00	852 1064
5.29	72	28	**17.63**	....	**1.91**	....	21.60	20.00	1089
3.04	74	26	**25.92**	....	**2.21**	....	28.89	27.00	1360
3.32	82	18	**20.42**	....	**2.12**	....	24.82	28.00	1116
3.43	72	28	**21.68**	....	**2.00**	....	24.98	28.00	841
6.52	79	21	**23.56**	....	**2.64**	....	28.53	26.00	1149
3.30	73	27	**28.89**	....	**2.00**	....	30.62	26.00	1125
4.71	70	30	**21.56**	....	**3.21**	....	27.75	20.00	1090
2.50	79	21	**17.62**	....	**2.10**	....	22.42	20.00	1088
7.50	52	48	**20.19**	....	**3.50**	....	26.26	30.00 25.00	849 1337
9.81	50	50	**20.78**	....	**3.59**	....	26.82	25.00	1337
1.12	79	21	**18.85**	....	**1.99**	....	23.18	28.00	839
4.99	56	44	**24.89**	21.00	**4.00**	3.30	31.22	25.00	1165
8.23	60	40	***21.35**	23.00	***3.66**	3.71	28.03	....	1044

*Constituent falls below guarantee.

GROUND BONE

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	JARECKI CHEMICAL CO., SANDUSKY, OHIO.	
837	Pure Ground Bone,	Clark Bros., Oil City,
	LISTER'S AGRICULTURAL CHEMICAL WORKS, NEWARK, N. J.	
1359	Pure Raw Bone Meal,	Wm. H. Fritz, Berwyn,
	MILLER FERTILIZER CO., BALTIMORE, MD.	
1181	Ground Bone,	M. T. Harkins, Hickory Hill,
	NELSON MORRIS & CO., CHICAGO, ILL.	
1084	Big Two Pure Bone Meal,	J. W. Scott & Co., Pittsburg, Pa.,
	OHIO FARMERS' FERTILIZER CO., COLUMBUS, O.	
1108	Fine Ground Bone Meal,	Thos. Lloyd, Brisbin,
	OSCEOLA FERTILIZER CO., OSCEOLA, PA.	
1106	Pie Brand Pure Ground Bone,	R. R. Fleming, Houtzdale,
	J. D. PERKINS, COATESVILLE, PA.	
1349	Pure Bone Meal,	J. D. Perkins, Coatesville,
	READING CHEMICAL & FERTILIZER CO., READING, PA.	
1374	Bone Meal,	Harry C. Moyer, Blooming Glen,
	SCHAAL-SHELDON FERTILIZER CO., ERIE, PA.	
1083 1105	†Pure Bone Meal,	G. R. Leslie, Edge Cliff, Pa., W. D. Gates, Curwensville,
	M. L. SHOEMAKER & CO., PHILADELPHIA, PA.	
1311	Pure Raw Bone Meal,	J. D. Mountz, Joanna,
1159	Pure Raw Ground Bone,	Chester Co. Assn. of Farmers, Kelton,
1160	Swift Sure Bone Meal,	Chester Co. Assn. of Farmers, Kelton,
	CHARLES A. SICKLER & BRO., WILKES-BARRE, PA.	
1008	Pure Ground Bone,	Ellis Eves & Bro., Millville,
	SOUTHERN FERTILIZER CO., YORK, PA.	
978	Pure Ground Bone,	F. Z. Stauffer, York,

For explanation of these tables see p. 792. †Composite sample.

FERTILIZERS—Continued.

Moisture in 100 pounds.	Mechanical Analyses.		Chemical Analyses.				Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
	Diameter less than 1-50 inch, "fine."	Diameter greater than 1-50 inch, "coarse."	Phosphoric Acid.		Nitrogen.				
			Found.	Guaranteed.	Found.	Guaranteed.			
4.00	75	25	**26.17**	20.00	**2.71**	2.47	30.42	28.00	837
4.29	64	36	**23.79**	23.00	**2.95**	2.68	28.44	35.00	1359
5.50	62	38	**16.05**	....	**2.65**	....	21.74	26.00	1181
5.17	80	20	**30.74**	21.00	***1.74**	2.06	32.01	25.00	1084
3.01	74	26	***13.97**	20.00	**2.70**	1.65	20.84	26.00	1108
6.28	69	31	**23.24**	22.83	**3.45**	3.34	29.61	27.50	1106
4.55	85	15	**27.02**	....	**2.51**	....	31.35	....	1349
6.92	61	39	***20.27**	22.00	**3.64**	1.65	27.28	....	1374
5.83	61	39	**23.78**	22.00	**3.77**	2.88	30.16	.... 29.00	1083 1165
6.93	67	33	**21.49**	20.00	**3.89**	2.47	29.23	29.50	1311
6.76	77	23	**22.11**	20.00	**3.70**	2.47	29.90	23.30	1159
3.62	89	11	**23.64**	20.00	**5.17**	4.12	35.78	21.30	1160
4.53	72	28	**24.72**	22.00	**2.72**	2.47	29.06	30.00	1008
5.13	65	35	**20.68**	18.30	**3.33**	3.30	27.15	27.00	978

*Constituent falls below guarantee.

GROUND BONE

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	SWIFT & CO., CHICAGO, ILL.	
1287	Raw Bone Meal,	Eli M. Martin, New Holland,
1152	†Special Bone Manure,	Fred. Zehner, Zelionople,
1340		Wilson & Mendenhall, Toughkenamon,
	WALKER STRATMAN & CO., PITTSBURG, PA.	
856	†Pure Raw Bone Meal,	Kirsch & Lieb, Spangler,
833		Chas. Redd, Cowansville,
1085		———, Harmarville,
	JOHN WHANN & SON, PHILADELPHIA, PA.	
1333	Pure Ground Bone,	Atwood Criswell, Collamer,
	W. E. WHANN, SPRING MILLS, PA.	
1169	Pure Raw Bone,	John A. Rockey, Atglen,

For explanation of these tables see p. 792. †Composite sample.

FERTILIZERS—Continued.

	Mechanical Analysis.		Chemical Analyses.						
			Phosphoric Acid.		Nitrogen.				
Moisture in 100 pounds.	Diameter less than 1-50 inch, "fine."	Diameter greater than 1-50 inch, "coarse."	Found.	Guaranteed.	Found.	Guaranteed.	Computed commercial value at Department rating. (See p. 712.)	Selling price at the point of selection.	Sample number.
6.31	56	44	**25.22**	23.00	**4.00**	3.71	31.42	26.00	1287
7.32	55	45	**33.98**	27.50	***.54**	.82	29.42	25.00	1152
								21.00	1340
								27.00	856
6.54	60	40	**23.93**	22.00	**3.58**	3.30	29.83	24.00	833
								25.20	1085
6.17	75	25	**22.88**	20.00	**3.36**	....	29.50	26.00	1333
6.55	67	33	***19.74**	20.00	**3.88**	2.47	27.91	25.00	1169

*Constituent falls below guarantee.

MISCELLANEOUS

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	M. L. SHOEMAKER & CO., PHILADELPHIA, PA.	
1164	Muriate of Potash,	Chester Co. Assn. of Farmers, Kelton, Pa.,
	GRIFFITH & BOYD, BALTIMORE, MD.	
1022	Genuine German Kainit,	A. B. Harnish, Mechanicsburg, Pa.,
	SENECA WHITE LIME COMPANY, FOSTORIA, OHIO.	
1077	Lime Fertilizer,	W. F. Barclay, Livermore, Pa.,

For explanation of these tables see p. 792. †Composite sample.

SAMPLES.

Moisture in 100 pounds.	Potash in 100 Pounds. (Water Soluble.) Present as muriate.	Present as sulphate.	Total. Found.	Total. Guaranteed.	Computed commercial value of 2,000 pounds at Department rating. (See p. 712.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
9.73	15.83	....	15.83	....	[illegible]	[illegible]	1461
8.45	14.21	....	14.21	12.0	[illegible]	[illegible]	1462

Constituent [illegible] below guarantee.

	Per cent.
Moisture,	11.27
Potash,	[illegible]
Lime,	47.17
Magnesia,	9.91
Iron oxide, alumina,	[illegible]
Sulphuric acid,	None.
Phosphoric acid,	.17
Carbonic acid,	2.24
Insoluble, sand, etc.,	[illegible]
Undetermined, soluble silica, etc.,	[illegible]
	[illegible]

LIST

OF

FERTILIZER MANUFACTURERS

WHO TOOK OUT

Licenses for the Sale of Commercial Fertilizers

IN

PENNSYLVANIA IN 1901,

TOGETHER WITH A LIST OF THE

VARIOUS LICENSED BRANDS OFFERED FOR SALE.

BRANDS OF FERTILIZERS LICENSED FOR SALE IN PENNSYLVANIA FOR THE YEAR 1901.

THE ABBOTT & MARTIN RENDERING CO., No. 232 N. High Street, Columbus, Ohio.

1. "Abbott's X X Brand."
2. "Ideal Grain Grower."

ALLEGHENY CITY FERTILIZER WORKS, Allegheny, Pa.

1. "Pure Raw Bone Phosphate."
2. "Pure Raw Bone Meal."
3. "Potato Manure."
4. "Banner Phosphate."
5. "Dissolved Bone and Potash."
6. "Odorless Lawn and Garden Plant Food."
7. "Full Value Phosphate."
8. "Butchers' Bone Meal."

THE ALLENTOWN MANUFACTURING CO., Allentown, Pa.

1. "High Grade Truck Phosphate."
2. "High Grade Potato Phosphate."
3. "Complete Bone Phosphate."
4. "Special $25.00 Phosphate."
5. "Phosphate and Potash."
6. "Pure Ground Bone."
7. "Acidulated Phosphate."

THE ALLIANCE FERTILIZER CO., Alliance O.

1. "Button Bone."
2. "Bone Black Phosphate and Potash."

AMERICAN REDUCTION COMPANY, No. 1942 Forbes Street, Pittsburg, Pa.

1. "Pittsburg Guano."
2. "Iron City."
3. "Common Sense."
4. "Vegetable Manure."
5. "Fine Ground Bone."

THE AMERICAN AGRICULTURAL CHEMICAL CO., No. 26 Broadway, New York, N. Y.

1. "Pure Ground Bone."
2. "Fine Ground Bone."
3. "Bone Meal."
4. "Muriate of Soda."
5. "Genuine German Kainit."
6. "Dissolved Animal Bone."

THE A. A. C. CO., BRADLEY BRANCH, P. O. Box 217, New York, N. Y.

1. "Bradley's Dissolved Bone and Potash."
2. "Bradley's Bean and Potato Phosphate."
3. "Bradley's Bean and Potato Phosphate."
4. "Bradley's Soluble Dissolved Bone."
5. "Bradley's Niagara Phosphate."
6. "Bradley's Potato Fertilizer."
7. "Bradley's Alkaline Bone with Potash."

THE A. A. C. CO., CANTON CHEMICAL BRANCH, P. O. Box 407, Baltimore, Md.

1. "Canton-Chemical C. C. C. Special Compound."
2. "Canton-Chemical Baker's Standard H. G. Guano."
3. "Canton-Chemical Game Guano."
4. "Canton-Chemical Baker's Fish Guano."
5. "Canton-Chemical Potato Manure."
6. "Canton-Chemical B. G. Ammoniated Bone."
7. "Canton-Chemical Resurgam Guano."
8. "Canton-Chemical Baker's Special Wheat, Corn and Grass Mixture."
9. "Canton-Chemical Harrow Brand Crop Grower."
10. "Canton-Chemical Eagle Phosphate."
11. "Canton-Chemical Soluble Alkaline Bone."
12. "Canton-Chemical Soluble Bone and Potash."
13. "Canton-Chemical Baker's Dissolved Bone Phosphate."
14. "Canton-Chemical Baker's Dissolved S. C. Bone."

THE A. A. C. CO., CHICOPEE GUANO BRANCH, No. 88 Wall Street, New York, N. Y.

1. "Chicopee Harvest Favorite.
2. "Chicopee Farmer's Reliable."
3. "Chicopee Standard Guano."

THE A. A. C. CO., CLARK'S COVE BRANCH, P. O. Box 1779, New York, N. Y.

1. "Clark's Cove Atlas Bone Phosphate."
2. "Clark's Cove Triumph Bone and Potash."
3. "Clark's Cove Defiance Complete Manure."
4. "Clark's Cove King Philip Alkaline Guano."
5. "Clark's Cove Potato and Hop Grower."

THE A. A. C. CO., CROCKER BRANCH, Buffalo, N. Y.

1. "Crocker's General Crop Grower."
2. "Crocker's Universal Grain Grower."
3. "Crocker's Complete Manure."
4. "Crocker's Complete New Rival Fertilizer."
5. "Crocker's Harvest Jewel Fertilizer."
6. "Crocker's Wheat and Corn Fertilizer."
7. "Crocker's Potato, Hop and Tobacco Fertilizer."
8. "Crocker's Ammoniated Bone Super-Phosphate."
9. "Crocker's Dissolved Bone and Potash."
10. "Crocker's Dissolved Bone Phosphate."

THE A. A. C. CO., CUMBERLAND BRANCH, No. 27 William Street, New York, N. Y.

1. "Cumberland Dissolved Bone Phosphate."
2. "Cumberland Bone and Potash."
3. "Cumberland Hawkeye Fertilizer."
4. "Cumberland Guano."
5. "Cumberland Potato Phosphate."
6. "Cumberland Ammoniated Dissolved Bone."

THE A. A. C. CO., DETRICK BRANCH, No. 26 Chamber of Commerce, Baltimore, Md.

1. "Detrick's Quickstep Bone Phosphate for Potatoes and Tobacco."
2. "Detrick's Kangaroo Komplete Kompound."
3. "Detrick's Royal Crop Grower."
4. "Detrick's Standard Potash Fertilizer."
5. "Detrick's Corn and Oats Fertilizer."
6. "Detrick's Imperial Compound."
7. "Detrick's Special Mixture."
8. "Detrick's Paragon Ammoniated Bone Phosphate and Potash."
9. "Detrick's P. & B. Special Fertilizer."
10. "Detrick's Bone and Potash (16x4) Mixture."
11. "Detrick's Soluble Bone Phosphate and Potash."
12. "Detrick's Dissolved S. C. Bone."
13. "Orchilla Guano."

THE A. A. C. CO., GREAT EASTERN BRANCH, Rutland, Vt.

1. "Great Eastern Northern Corn Special."
2. "Great Eastern Vegetable, Vine and Tobacco."
3. "Great Eastern Wheat Special."
4. "Great Eastern General."
5. "Great Eastern English Wheat Grower."
6. "Great Eastern Soluble Bone and Potash."
7. "Great Eastern Dissolved Bone."

THE A. A. C. CO., LAZARETTO GUANO BRANCH, Merchants' Bank Building, Baltimore, Md.

1. "Lazaretto Special for Tobacco and Potatoes."
2. "Lazaretto Retriever Animal Bone Fertilizer."
3. "Lazaretto Crop Grower."
4. "Lazaretto Bone Compound."
5. "Lazaretto Special Potato Fertilizer."
6. "Lazaretto Ammoniated Bone Phosphate."
7. "Lazaretto Excelsior A. A. A."
8. "Lazaretto Dissolved Bone and Potash."
9. "Lazaretto Dissolved Bone Phosphate."

THE A. A. C. CO., MARYLAND BRANCH, No. 30 S. Holliday Street, Baltimore, Md.

1. "Maryland Ammoniated Bone."
2. "Maryland O. K. Ammoniated Fertilizer."

3. "Maryland Alkaline Bone."
4. "Maryland Linden Super-Phosphate."
5. "Maryland Bono Super-Phosphate."
6. "Maryland Dissolved S. C. Phosphate."
7. "Maryland Compound for Potatoes and Tobacco."

THE A. A. C. CO., MICHIGAN CARBON WORKS BRANCH, Detroit, Mich.

1. "Red Line Phosphate."
2. "Red Line Phosphate with Potash."
3. "Red Line Complete Manure."
4. "General Crop Fertilizer."
5. "Homestead "A" Bone Black Fertilizer."

THE A. A. C. CO., MILSOM BRANCH, East Buffalo, N. Y.

1. "Milsom's Erie King Fertilizer."
2. "Milsom's Wheat, Oats and Barley Fertilizer."
3. "Milsom's Buffalo Guano."
4. "Milsom's Buffalo Fertilizer."
5. "Milsom's Potato, Hop and Tobacco Fertilizer."
6. "Milsom's Corn Fertilizer."
7. "Milsom's Vegetable Bone Fertilizer."
8. "Milsom's Dissolved Bone and Potash."
9. "Milsom's Acid Phosphate."

THE A. A. C. CO., MORO-PHILLIPS BRANCH, No. 708 The Bourse, Philadelphia, Pa.

1. "Moro-Phillips Pure Phuine."
2. "Moro-Phillips Soluble Bone Phosphate."
3. "Moro-Phillips Wheat Special."
4. "Moro-Phillips No. 1 Potato and Truck Manure."
5. "Moro-Phillips Farmers' Phosphate."
6. "Moro-Phillips Farmers' Potato Mixture."
7. "Moro Phillips Alkaline Bone Phosphate."
8. "Moro-Phillips Special Fertilizer."
9. "Moro-Phillips C. & G. Complete Fertilizer."
10. "Moro-Phillips N. J. Potato Manure."
11. "Moro-Phillips Standard Guano."
12. "Moro-Phillips Standard Phosphate."

THE A. A. C. CO., NIAGARA BRANCH, P. O. Box 189, Buffalo, N. Y.

1. "Niagara Grain and Grass Grower."
2. "Niagara Wheat and Corn Producer."
3. "Niagara Potato, Tobacco and Hop Fertilizer."
4. "Niagara Triumph Fertilizer."
5. "Niagara Dissolved Bone and Potash."
6. "Niagara Dissolved Bone Phosphate."

THE A. A. C. CO., PACIFIC GUANO BRANCH, P. O. Box 2350, New York, N. Y.

1. "Pacific Dissolved Bone Phosphate."
2. "Pacific Dissolved Bone and Potash."
3. "Pacific A. No. 1 Phosphate."

4. "Pacific Nobsque Guano."
5. "Pacific Soluble Guano."
6. "Pacific Special Potato Manure."
7. "Pacific Potato Phosphate."
8. "Pacific H. G. General Fertilizer."

THE A. A. C. CO., PACKERS UNION BRANCH, Rutland, Vt.

1. "Packers Union Gardeners' Complete Manure."
2. "Packers Union Animal Corn Fertilizer."
3. "Packers Union Potato Manure."
4. "Packers Union Universal Fertilizer."
5. "Packer's Union American Wheat and Rye Grower."
6. "Packers Union Banner Wheat Grower."
7. "Packers Union Acidulated Bone."

THE A. A. C. CO., QUINNIPIAC BRANCH, No. 27 William Street, New York, N. Y.

1. "Quinnipiac Soluble Dissolved Bone."
2. "Quinnipiac Dissolved Bone and Potash."
3. "Quinnipiac Mohawk Fertilizer."
4. "Quinnipiac Climax Phosphate."
5. "Quinnipiac Ammoniated Dissolved Bone."
6. "Quinnipiac Special Potato."

THE A. A. C. CO., READ BRANCH, No. 88 Wall Street, New York, N. Y.

1. "Read's Standard Super-Phosphate."
2. "Read's Leader Blood and Bone."
3. "Read's Farmers' Friend Super-Phosphate."
4. "Read's Acid Phosphate (14 per cent.)."
5. "Read's Bone and Potash."
6. "Read's Vegetable and Vine Fertilizer."
7. "Read's Practical Potato Special."

THE A. A. C. CO., REESE BRANCH, Equitable Building, Baltimore, Md.

1. "Reese's Potato and Truck Special."
2. "Reese's Standard."
3. "Reese's Potato Phosphate."
4. "Reese's Mayflower."
5. "Reese's Potato Manure."
6. "Reese's Ammoniated Bone Phosphate Mixture."
7. "Reese's Harvest Queen."
8. "Reese's Pilgrim Fertilizer."
9. "Reese's Challenge Crop Grower."
10. "Reese's Half and Half."
11. "Reese's High Grade Potash Mixture, 12x5."
12. "Reese's Crown Phosphate and Potash."
13. "Reese's Grass and Grain."
14. "Reese's Wheat Special."
15. "Reese's Dissolved Phosphate of Lime."
16. "Reese's Elm Phosphate."

THE A. A. C. CO., SHARPLESS & CARPENTER BRANCH, No. 124 S. Delaware Avenue, Philadelphia, Pa.

1. "Sharpless & Carpenter Corn and Truck Guano."
2. "Sharpless & Carpenter Farmers' Imp. Potato Manure."
3. "Sharpless & Carpenter Gilt Edge Potato and Tobacco Manure."
4. "Sharpless & Carpenter No. 1 Bone Phosphate."
5. "Sharpless & Carpenter Royal Spring Mixture."
6. "Sharpless & Carpenter Soluble Bone and Potash."
7. "Sharpless & Carpenter Farmers' Bone Phosphate."
8. "Sharpless & Carpenter Dis. Bone Phos. for Potatoes and General Use."
9. "Sharpless & Carpenter No. 2 for Grain and Grass."
10. "Sharpless & Carpenter Soluble Tampico Guano."
11. "Sharpless & Carpenter Acid Phosphate."

THE A. A. C. CO., STANDARD BRANCH, No. 40 Exchange Place, New York, N. Y.

1. "Standard Dissolved Bone Phosphate."
2. "Standard Bone and Potash."
3. "Standard "A" Fertilizer."
4. "Standard Guano."
5. "Standard Ammoniated Dissolved Bone."
6. "Standard Potato Grower."

THE A. A. C. CO., SUSQUEHANNA BRANCH, Cor. South and Water Streets, Baltimore, Md.

1. "Susquehanna Potato Phosphate."
2. "Susquehanna Pure Bone Phosphate."
3. "Susquehanna Ammoniated Bone Phosphate."
4. "Susquehanna Bone Phosphate."
5. "Susquehanna X. X. V. Phosphate."
6. "Susquehanna Crop Grower."
7. "Susquehanna High Grade Bone and Potash."
8. "Susquehanna Alkaline Bone Phosphate."
9. "Susquehanna Superior Rock Phosphate."
10. "Susquehanna Soluble Bone Phosphate."

THE A. A. C. CO., TYGERT-ALLEN BRANCH, No. 708 The Bourse, Philadelphia, Pa.

1. "Tygert-Allen Gold Edge Tobacco Manure."
2. "Tygert-Allen Star Guano."
3. "Tygert-Allen Star Potato Grower."
4. "Tygert-Allen Star Dissolved Bone Phosphate."
5. "Tygert-Allen Star Soluble Bone and Potash."
6. "Tygert-Allen Star Bone Phosphate."
7. "Tygert-Allen Star Tobacco Manure."
8. "Tygert-Allen Potato Fertilizer."
9. "Tygert-Allen Standard Bone Phosphate."
10. "Howitz's Acid Phosphate."
11. "Howitz's Azotized Dissolved Bone."
12. "Howitz's Soluble Bone Phosphate."
13. "Allen's Popular Phosphate."

14. "Allen's Special Brand Potato Manure."
15. "Allen's Special for Wheat and Grass."
16. "Allen's Nitro Phosphate."
17. "Allen's Alkaline Bone Phosphate."
18. "Schneitman's Ammoniated Bone Phosphate."
19. "Yearsley's Philadelphia Standard Phosphate."
20. "Yearsley's Chester County Bone Phosphate."

THE A. A. C. CO., M. E. WHEELER & CO. BRANCH, Rutland, Vt.

1. "Wheeler's Corn Fertilizer."
2. "Wheeler's Potato Manure."
3. "Wheeler's Superior Truck."
4. "Wheeler's Royal Wheat Grower."
5. "Wheeler's Wheat and Clover Fertilizer."
6. "Wheeler's Electrical Dissolved Bone."

THE A. A. C. CO., WILLIAMS & CLARK BRANCH, No. 27 William Street, New York, N. Y.

1. "Williams & Clark Acorn Acid Phosphate."
2. "Williams & Clark Dissolved Bone and Potash."
3. "Williams & Clark Prolific Fertilizer."
4. "Williams & Clark Royal Bone Phosphate."
5. "Williams & Clark American High Grade Special."
6. "Williams & Clark Americus Universal Ammoniated Dis. Bone."

THE A. A. C. CO., ZELL GUANO BRANCH, No. 32 South Street, Baltimore, Md.

1. "Zell's Special Compound for Potatoes and Vegetables."
2. "Zell's Ammoniated Bone Super-Phosphate."
3. "Zell's Hustler Phosphate."
4. "Zell's Economizer Phosphate."
5. "Zell's Little Giant."
6. "Zell's Dissolved Bone Phosphate and Potash."
7. "Zell's Electric Phosphate."
8. "Zell's Dissolved Bone Phosphate."

AMWAY, J. L., Mt. Joy, Pa.

1. "Improved Phosphate."

ANSTINE, A., Stewartstown, Pa.

1. "Bone Phosphate."

THE ARMOUR FERTILIZER WORKS, No. 205 Lasalle Street, Chicago, Ill.

1. "Bone Meal."
2. "Raw Bone Meal."
3. "Phosphate and Potash."
4. "Wheat, Corn and Oats Special."
5. "Ammoniated Bone and Potash."
6. "Fruit and Root Crop Special."
7. "All Soluble."
8. "Bone, Blood and Potash."

9. "Armour's Wheat Special."
10. "High Grade Potato."
11. "Grain Grower."
12. "Starr Phosphate."
13. "Cereal Phosphate."
14. "Phosphate and Potash No. 2."

AUCKER, R. S., Shamokin, Pa.

1. "Bone Meal."
2. "Bone Meal with Potash."
3. "High Grade Bone and S. H. Phosphate."
4. "Grade A. Bone and Slaughter House Phosphate."
5. "Grade B. Bone and Slaughter House Phosphate."
6. "Grade C. Bone and Slaughter House Phosphate."
7. "Grade D. Bone and Slaughter House Phosphate."
8. "Grade E. Bone and Slaughter House Phosphate."
9. "Economy Potash Phosphate."
10. "High Grade Acid Phosphate."

BALTIMORE PULVERIZING COMPANY, Nos. 13 and 15 North Street, Baltimore, Md.

1. "Penniman's Excelsior Fertilizer."
2. "Farmers' Favorite Fertilizer."
3. "Special Spring and Fall Mixture."

BARTENSCHLAGER, J. H., Stewartstown, Pa.

1. Bartenschlager's Champion Bone Phosphate."

BAUGH & SONS COMPANY, No. 20 S. Delaware Avenue, Philadelphia, Pa.

1. "Baugh's Bone Meal, Warranted Pure."
2. "Baugh's Pure Dissolved Animal Bone."
3. "Export Bone with Potash."
4. "Baugh's Animal Bone and Potash—Compound for all Crops."
5. "The Twenty-five Dollar Phosphate."
6. "Baugh's Double Eagle Phosphate."
7. "Baugh's General Crop Grower—For all Crops."
8. "Baugh's Soluble Alkaline Super-Phosphate."
9. "Baugh's Wheat Fertilizer—For Wheat and Grass."
10. "Baugh's Potato Fertilizer."
11. "Baugh's Corn Fertilizer—For Sugar Corn and Garden Truck."
12. "The Wrapper Leaf Brand—A Special Manure for Seed Leaf Tobacco."
13. "Baugh's Special Potato Manure."
14. "Baugh's High Grade Acid Phosphate."

BAUGHMAN, WILLIAM F., Rinely, Pa.

1. "P. & T. Special."
2. "Ammoniated Bone Phosphate."
3. "Harvest Queen Phosphate."

BAXTER, H. V., Chester, Pa.

1. "Pure Ground Bone."
2. "I. X. L. Phosphate."

BECKERT, W. C., No. 129 Federal Street, Allegheny, Pa.

1. "Odorless Special Lawn and Garden Fertilizer."

BERG COMPANY, THE, Port Richmond, Philadelphia, Pa.

1. "Berg's Special Potato Guano."
2. "Berg's Lymph Guano for all Crops."
3. "Berg's $35.00 Potato Manure."
4. "Berg's Standard Bone Manure."
5. "Berg's Pure Dissolved Bone and Potash."
6. "Berg's Pure Raw Bone Fine."
7. "Berg's Special $25.00 Bone Manure."

BERGER BROTHERS, Easton, Pa.

1. "Berger Bros. H. G. Acid Phosphate."
2. "Peerless."
3. "Wheat and Grass."
4. "Lehigh Super-Phosphate."
5. "Potato and Truck."

BLAKER, A. H., & CO., Fox Chase, Philadelphia, Pa.

1. "Blaker's Acid Phosphate."
2. "Blaker's Poudrette."
3. "Blaker's Wheat and Corn."
5. "Blaker's Potato."

BLOCHER, D., & CO., Gettysburg, Pa.

1. "Dissolved Raw Bone and Potash."
2. "High Grade Super-Phosphate of Bone."
3. "Ammoniated Soluble Bone Phosphate."
4. "Alkaline Bone."
5. "Soluble Bone Phosphate."

BONDAY, JAMES, JR., & CO., No. 302 Merchants' Bank Building, Baltimore, Md.

1. "Sulphate of Potash."
2. "Muriate of Potash."
3. "German Kainit."

BOWKER FERTILIZER COMPANY, THE, No. 43 Chatham Street, Boston, Mass.

1. "Stockbridge Potato and Vegetable."
2. "Bowker's Potash or Staple Phosphate."
3. "Bowker's Sure Crop Phosphate."
4. "Bowker's Ammoniated O. I. O."
5. "Bowker's Super-Phosphate and Potash."
6. "Bowker's Apex Phosphate."
7. "Bowker's Dissolved Bone Phosphate."
8. "Bowker's 6 per cent. Potash Manure."
9. "Bowker's Potash Bone."
10. "Bowker's Empire State Bone Phosphate."

11. "Bowker's Hill and Drill Phosphate."
12. "Bowker's Farm and Garden Phosphate."
13. "Bowker's Wheat Grower."

BOYD, D. M., JR., Danville, Pa.

1. "Farmers' Companion."
2. "Pure Ground Bone."

BRADLEY & GREEN FERTILIZER CO., Ninth Street and Girard Avenue, Philadelphia, Pa.

1. "Potato Guano No. 1."
2. "Harvest Home."
3. "High Grade Acid Phosphate."
4. "Popular Phosphate—Special for Wheat."
5. "Standard Bone Phosphate—For Corn, Wheat and Peas."
6. "High Grade Special Tobacco Fertilizer."
7. "Market Garden."

BRILLINGER, HORACE, Emigsville, Pa.

1. "Brillinger's Special Wheat, Corn and Grass Mixture."
2. "Standard High Grade Phosphate."

BRODBECK, S. B., Brodbecks, Pa.

1. "Standard Ammoniated."
2. "Reliable Ammoniated."
3. "Alkaline."
4. "Ruth's Dissolved Bone."

BROWN, J. W., Tilden, York County, Pa.

1. "No. 7. Compound Fertilizer."

BRUBACHER, ELIAS S., Millbach, Pa.

1. "Wheat and Grass Special."

CAMBRIA FERTILIZER COMPANY, Johnstown, Pa.

1. "Pure Ground Bone Dust."
2. "Lion Phosphate."
3. "Standard Phosphate."
4. "Corn and Potato Manure."
5. "B. & B. Phosphate."

CHICAGO FERTILIZER CO., THE, Security Building, Chicago, Ill.

1. "Mt. Pleasant Phosphate."
2. "No. 1 Acid Phosphate."
3. "Wheat Special."
4. "Bone, Blood and Potash."
5. "Potash Special."
6. "Chicago Bone Meal."

COE COMPANY, E. FRANK, No. 133 Front Street, New York, N. Y.

1. "High Grade Soluble Bone."
2. "X. X. V. Phosphate. (Ammoniated Bone.)"
3. "Prize Brand Grain Fertilizer."
4. "Special Dissolved—Bone and Potash."
5. "High Grade Acid Phosphate."
6. "Pennsylvania Grain Special."
7. "Columbian Corn Fertilizer."
8. "Columbian Phosphate."
9. "High Grade Ammoniated Bone Phosphate."
10. "Columbian Potato Fertilizer."
11. "High Grade Potato Fertilizer."
12. "XXX Acid Phosphate."

COPE, HENRY, & COMPANY, Lincoln University, Pa.

1. "Acid Phosphate."
2. "Soluble Bone and Potash."
3. "Ammoniated Bone Phosphate."
4. "Pure Bone Phosphate."
5. "Potato and Corn Phosphate."
6. "Dead Shot Phosphate."
7. "Pure Ground Bone."
8. "Queen of Elk Valley."
9. "New Century Bone Phosphate."
10. "Pennsylvania Wheat Grower and C. Manure."
11. "High Grade Soluble Bone and Potash."
12. "Pure Steamed Bone."

COPE, JOSIAH, & COMPANY, Lincoln University, Pa.

1. "Pure Bone Phosphate."
2. "Try Me Bone Phosphate."
3. "Ammoniated Bone Phosphate."
4. "Wheat and Grass Special."
5. "Potato and Tobacco Phosphate."
6. "Acid Phosphate."
7. "Soluble Bone and Potash."
8. "Pure Steamed Bone."
9. "Ground Raw Bone."

CRANSTON COMPANY, J. A., Wilmington, Del.

1. "W. B. Raw Bone Super-Phosphate."
2. "Pennsylvania Super-Phosphate."
3. "Horse Shoe Soluble Bone."
4. "Horse Shoe Soluble Bone and Potash."

DARON, E., Dover, Pa.

1. "Daron's Harvest King Bone Phosphate."

DOWNWARD & COMPANY, JAMES G., Coatesville, Pa.

1. "Ammoniated Bone Phosphate."
2. "Soluble Bone and Potash."

3. "Special Wheat and Grass Fertilizer."
4. "Acid Phosphate Rock."
5. "Royal Bone Phosphate."
6. "Special Potato Fertilizer."
7. "Special Corn Manure."
8. "Pure Ground Bone."
9. "Pioneer Raw Bone Phosphate."

DUNGAN, WALLACE, Doylestown, Pa.

1. "Pebel Hill Home Made Animal Bone Mixture."
2. "Bone Flour."

EASTERN CHEMICAL COMPANY, No. 620 Atlantic Avenue, Boston, Mass

1. "Imperial Liquid Plant Food."

EBY, AMOS, Lehman Place, Pa."

1. "Pequea Bone."
2. "Pequea Economy."
3. "Pequea Ammoniated."
4. "Pequea Bone for Potatoes."
5. "Farmers' Mixture."

EUREKA FERTILIZER COMPANY, Perryville, Md.

1. "Farmers' Favorite Bone Phosphate."
2. "Standard Bone Phosphate."
3. "Grain and Grass Mixture."
4. "Corn and Potato Special."
5. "P. & P. Super-Phosphate."
6. "Potato and Vegetable Fertilizer."
7. "Imperial Bone Phosphate."
8. "Fish, Rock and Potash."
9. "Alkaline Bone and Potash."
10. "Ground Raw Bone."
11. "Wrapper Leaf Brand."

EWING, WASHINGTON, Landenberg, Pa.

1. "Pure Raw Bone."
2. "Eclipse Raw Bone Phosphate."
3. "Waste Land Potato Phosphate."

FAIRLAMB, R. C., & SONS, Brandywine Summit, Pa.

1. "Potato Special."
2. "Corn Special."
3. "Wheat and Grass Special."

FARMERS' FERTILIZER COMPANY, Westminster, Md.

1. "No. 1 Bone Phosphate."
2. "No. 3 Bone Phosphate."
3. "X. X. Bone Phosphate."
4. "Carroll Bone Phosphate."
5. "P. A. & P. Phosphate."
6. "Acid Phosphate."

FARMER, W. S., & CO., No. 21 S. Gay Street, Baltimore, Md.

1. "Standard Phosphate."
2. "Harvest Queen Phosphate."
3. "Clyde Brand Phosphate."
4. "B. & P. Phosphate."
5. "Dissolved S. C. Bone."

FOGLEMAN, W. H., Williamsport, Pa.

1. "Raw Bone and Potash."

FRETZ, H. E., Fretz, Pa.

1. "Fretz's Harvest Queen."
2. "Fretz's $20.00 Bone Manure."

FRETZ, MAHLON, Sellersville, Pa.

1. "Fretz's Standard Bone Phosphate."

FULTON, JAMES, & SONS CO., Stewartstown, Penna.

1. "Fulton's Wheat and Corn Fertilizer."

GAWTHROP, JOSEPH R., Kennett Square, Pa.

1. "Fine Ground Raw Bone Meal."
2. "Champion Bone Fertilizer."
3. "Complete Ammoniated Bone Phosphate."
4. "Special Potato and Truck Phosphate."
5. "Acid Phosphate Rock."

GRIFFITH & BOYD, No. 9 S. Gay Street, Baltimore, Md.

1. "Cereal Bone Plant Food."
2. "Valley Fertilizer."
3. "Peerless Fertilizer."
4. "High Grade Acid Phosphate."
5. "Harvest Queen Phosphate."
6. "X. X. Potash Manure."
7. "Original Super-Phosphate."
8. "Farmers' Potato Manure."
9. "Ammoniated Bone Phosphate."
10. "Farmers' Improved Phosphate."
11. "Tobacco Grower."
12. "Genuine German Kainit."
13. "Spring Crop Grower."
14. "Pure Fine Ground Bone Meal."
15. "Fish, Bone and Potash."
16. "Special Grain Grower."
17. "Tiger Brand."

GROVE, A. M., & CO., Muddy Creek Forks, Pa.

1. "A. M. G. & Co's Special Potato Fertilizer."

HAGER, H. F., Quakertown, Pa.

1. "Hager's Ammoniated Super-Phosphate."
2. "Panic Phosphate."
3. "Farmers' Favorite Phosphate."

HAINES, THOMAS, & CO., Malvern, Pa.

1. "New Century Crop Grower."

HANOVER FERTILIZER COMPANY, N. E. Cor. Gay and Lombard Streets, Baltimore, Md.

1. "Dissolved S. C. Rock."
2. "Royal Bone and Potash."
3. "Farmers' Crop Winner."
4. "Blood and Bone Compound."
5. "Excelsior Combine."
6. "Klondyke Special."
7. "Pure Bone Meal."
8. "Hanover Acid Phosphate."

HART, JACOB, Mountain Grove, Pa.

1. "Ground Bone."

HASTINGS, WILLIAM S., & SON, Atglen, Pa.

1. "Clear Acid Phosphate."
2. "Octarora No. 1 Bone Phosphate."
3. "Atglen Corn and Potato Guano."
4. "Grain and Grass Special."

HESS, S. M., & BRO., S. E. Cor. Fourth and Chestnut Streets, Philadelphia, Pa.

1. "Ammoniated Bone Super-Phosphate."
2. "Keystone Bone Phosphate."
3. "Wheat and Grass Mixture."
4. "Emperor Phosphate."
5. "Potato and Truck Manure."
6. "Acid Phosphate."
7. "Ground Bone."
8. "Special Compound."
9. "Special Corn Manure."
10. "Special Potato Manure."
11. "Soluble Bone."
12. "Soluble Bone and Potash."
13. "Tobacco Manure."

HOFFMAN, P., & BRO., Raubsville, Pa.

1. "Potato Phosphate."
2. "King Phosphate."

HUBBARD & COMPANY, M. P., & CO., No. 612 Equitable Building, Baltimore, Md.

1. "Bermuda Guano."
2. "Celebrated Dissolved Bone Phosphate."
3. "Farmers' Acme."
4. "Harvest King."
5. "Farmers' Old Economy."
6. "Soluble Bone and Potash."
7. "Hubbard's High Grade S. C. Phosphate."

HUBBARD FERTILIZER COMPANY, THE, No. 708 Merchants' Bank Building, Baltimore, Md.

1. "Hubbard's Standard Bone Super-Phosphate."
2.
3. "Hubbard's Farmer's I. X. L. Super-Phosphate."
4. "Hubbard's Wheat Grower's Jewel."
5. "Hubbard's Oriental Phosphate."
6. "Hubbard's Columbia Gem Phosphate."
7. "Hubbard's Soluble Bone and Potash."
8. "Hubbard's High Grade Soluble Tennessee Phosphate."
9. "Hubbard's Trucker's 7 Per Cent. Royal Seal Compound."

INDEX COMPANY, THE, No. 426 N. Third Street, Philadelphia, Pa.

1. "Radix Fertilizer."
2. "Index Bone Phosphate."
3. "Ground Bone."
4. "Bone Meal."
5. "Bone Flour."
6. "Spiro Bone Meal."

INTERNATIONAL SEED COMPANY, Rochester, N. Y.

1. "International Grain and Grass Fertilizer."
2. "International Potato and Truck Manure."
3. "International A. L. Special Manure."

JARECKI CHEMICAL COMPANY, Sandusky, Ohio.

1. "Lake Erie Fish Guano."
2. "Fish and Potash Grain Special."
3. "Number One Fish Guano."
4. "C. O. D. Phosphate."
5. "Ground Bone."
6. "St. Bernard Phosphate."
7. "Dissolved Bone Black Wheat Special."
8. "Fish and Potash Tobacco and Potato Food."
9. "O. K. Fertilizer."
10. "Dissolved Bone with Potash."

JOHN'S, J. L., & CO., Millville, Pa.

1. "John's Pride of Columbia."
2. "John's Wheat and Buckwheat Special."
3. "John's Ammoniated Bone Phosphate."
4. "John's Acid Phosphate."

JONES, W. C., SONS, Doe Run, Pa.

1. "High Grade Dissolved S. C. Rock."
2. "Complete Fertilizer."
3. "Pure Ground Bone."

KENDERDINE, F. S., & SONS, Newtown, Pa.

1. "Kenderdine's Potato Phosphate."
2. "Kenderdine's Bone Phosphate."
3. "Kenderdine's Ammoniated Phosphate."

KEYSTONE FERTILIZER CHEMICAL CO., No. 3 S. Front Street, Philadelphia, Pa.

1. "Keystone Special Potato Manure."
2. "Keystone Harvest Queen."
3. "Keystone Wheat and Grass."
4. "Keystone Soluble Bone."

KRUG, GEORGE V., Kingsdale, Pa.

1. "Krug's X. X. Acid Phosphate."
2. "Krug's Ammoniated Bone Phosphate."

KUHNS, DAVID, Lehighton, Pa.

1. "Pure Ground Bone Meal."

KURTZ & STUNKARD, Green Bank, Pa.

1. "Conestoga Regulator."
2. "Conestoga Fancy."

LACKAWANNA FERTILIZER & CHEMICAL CO., Moosic, Pa.

1. "Moosic Phosphate."
2. "Special Manure."
3. "Admiral Dewey."
4. "Bone Super-Phosphate."
5. "Alkaline Bone."
6. "Warranted Pure Ground Bone."
7. "Acid Phosphate."
8. "Big Yield."

LANCASTER CHEMICAL COMPANY, Lancaster, Pa.

1. "Tobacco and Vegetable."
2. "Dewey Brand."
3. "Pure Dissolved Ammoniated Bone and Potash."
4. "Rising Sun Ammoniated Bone."
5. "Pure Dissolved Ammoniated Bone."
6. "Flag Brand."
7. "Hard Times Fertilizer."
8. "Economical Fertilizer."
9. "Acid Phosphate."
10. "Keystone Brand."
11. "Alkaline Bone."
12. "Bone Meal."

LEBERNIGHT, B. F., Red Lion, Pa.

1. "Lebernight's Standard Ammoniated Bone Phosphate."

LEIB, J. C., & CO., Stewartstown, Pa.

1. "Gemmills Mixture."

LETHERBURY, A. B., Chester, Pa.

1. "Chester Brand Bone Phosphate."

LEVAN, DANIEL, Lebanon, Penna.

1. "General Crop Grower."
2. "Wheat and Grass Special."
3. "Special Wheat Producer."

LISTER'S AGRICULTURAL CHEMICAL WORKS, Newark, N. J.

1. "Special Corn and Potato."
2. "Success Fertilizer."
3. "Harvest Queen."
4. "Crop Producer."
5. "Standard."
6. "No. 2 Potato Fertilizer."
7. "Bone and Potash."
8. "Special 10 Per Cent. Potato."
9. "A. D. Bone."
10. "U. S. Phosphate."
11. " "G" Brand."
12. "Special Fertilizer for Wheat and Rye."
13. "Lister's Cabbage and Cauliflower."
14. "Lawn Fertilizer."
15. "Pure Bone Meal."
16. "Celebrated Ground Bone."

McCALMONT & COMPANY, Bellefonte, Pa.

1. "McCalmont & Co's $25.00 Ammoniated Bone Super-Phosphate.'
2. "McCalmont & Co's High Grade Florida Bone Phosphate."

MAPES FORMULA AND PERUVIAN GUANO CO., No. 143 Liberty Street, New York, N. Y.

1. "Mapes Potato Manure."
2. "Mapes Tobacco Starter Improved."
3. "Mapes Tobacco Manure (Wrapper Brand)."
4. "Mapes Fruit and Vine Manure."
5. "Mapes Vegetable Manure or Complete Manure for Light Soils."
6. "Mapes Average Soil Compound Manure."
7. "Mapes Economical Potato Manure."
8. "Mapes Cauliflower and Cabbage."
9. "Mapes Corn Manure."
10. "Mapes Complete Manure, "A" Brand."
11. "Mapes Complete Manure for General Use."
12. "Mapes Ammoniated Dissolved Bone with Potash."
13. "Mapes Cereal Brand."
14. "Mapes Grain Brand."
15. "Mapes General Crop Brand."
16. "Pure Ground Bone."

MARKEL, NOAH, Seitzland, Pa.

1. "Markel's Ammoniated Bone Phosphate."
2. "Markel's Potato Grower."
3. "Markel's Electric Phosphate."

MEHRING, FREDERICK, Bruceville, Pa.

1. "Dissolved Raw Bone."
2. "Twenty-five Dollar Phosphate."
3. "General Crop Grower."
4. "Acid Phosphate."

MILLER FERTILIZER COMPANY, No. 411 E. Pratt Street, Baltimore, Md.

1. "Ammoniated Dissolved Bone."
2. "Harvest Queen."
3. "Special Potato."
4. "Hustler Phosphate."
5. "W. G. Phosphate."
6. "Standard Phosphate."
7. "Clinch Phosphate."
8. "S. C. Rock."

MORRIS, NELSON & CO., Union Stock Yards, Chicago, Ill.

1. "Big Two. Pure Bone Meal."
2. "Big Three. Pure Bone Phosphate."
3. "Big One."
4. "Big Four."
5. "Big Five."

MOWREY LATSHAW HARDWARE CO., THE, Spring City, Pa.

1. "Red Clover Brand."

NELLER, AUG., & CO., Stewartstown, Pa.

1. "Prolific Phosphate."
2. "Special Compound Phosphate."

NEWPORT, WILLIAM C., CO., Willow Grove, Pa.

1. "Evan's Brand Potato and Tobacco Manure."
1. "Rectified Phosphate."
3. "Gilt Edge Potato Manure."
4. "Fish, Bone and Potash."
5. "No. 1 for Potatoes, Corn and Truck."
6. "Farmer's Ammoniated Bone Phosphate."
7. "Grain and Grass Special."
8. "All Crop Fertilizer."
9. "Soluble Bone and Potash."
10. "Clear Acid Phosphate."
11. "Raw Bone Meal."
12. "Newport's Special Compound for Wheat and Grass."
13. "No. 1 Bone Phosphate.'
14. "Newport's Pure Bone Dust."
15. "Schneitmans Ammoniated Bone Phosphate."
16. "Schneitmans Anti-Trust Special Compound for Wheat and Grass."

OBER, G., & SONS' CO., No. 33 S. Gay Street, Baltimore, Md.

1. "Ober's Special Fertilizer for all Crops."
2. "Ober's Farmers' Mixture."
3. "Ober's Dissolved Bone Phosphate and Potash."
4. "Ober's Dissolved Bone Phosphate."

OHIO FARMERS' FERTILIZER CO., Columbus. O.

1. "Acid Phosphate."
2. "Superior Phosphate."
3. "Soluble Bone and Potash."
4. "Capital City Phosphate."
5. "General Crop Fish Guano."
6. "Corn, Oats and Wheat Fish Guano."
7. "Improved Wheat Maker."
8. "Ammoniated Bone and Potash."
9. "Excelsior Guano."
10. "Fine Ground Bone Meal."

OSCEOLA FERTILIZER COMPANY, Osceola Mills, Pa.

1. "Pie Brand Ground Bone."

OWENS, W. C., Philipsburg, Pa.

1. "Owens' Ammoniated Phosphate."

PATAPSCO GUANO COMPANY, P. O. Box 213, Baltimore, Md.

1. "Patapsco Pure Ground Bone."
2. "Patapsco Soluble Bone and Potash."
3. "Patapsco Fish Guano."
4. "Patapsco Special Wheat Compound."
5. "Sea Gull Guano."
6. "Coon Brand Guano."
7. "Baltimore Soluble Phosphate."
8. "Patapsco Dissolved S. C. Bone."
9. "Grange Mixture."
10. "Patapsco Grain and Grass Producer."
11. "Patapsco Early Trucker."
12. "Patapsco Tobacco and Potato Fertilizer."
13. "Patapsco Corn and Tomato Fertilizer."
14. "Patapsco High Grade Bone and Potash."

PATTERSON FERTILIZER CO., No. 4025 Market Street, Philadelphia, Pa.

1. "Patterson's Mineral Compound."

PENNSYLVANIA AMMONIA AND FERTILIZER CO., LIM., Harrisburg, Pa.

1. "Special Potato, Vegetable and Tobacco Fertilizer."
2. "Dauphin Brand."
3. "Special Brand."
4. "Pure Ground Bone."
5. "Capital Bone Super-Phosphate."

PERKINS, A. W., & CO., Rutland, Vt.

1. "Plantene."

PERKINS, J. DOUGLASS, Coatesville, Pa.

1. "Perkins' Monarch H. G. Bone and Potash Phosphates."
2. "Perkins' Ammoniated Bone Phosphate."
3. "Perkins' Special Bone Manure."
4. "Perkins' Globe Phosphate."
5. "Perkins' High Grade Acid Phosphate."

PIEDMONT-MT. AIRY GUANO CO., THE, No. 109 Commerce Street, Baltimore, Md.

1. "Levering's Standard."
2. "Piedmont High Grade S. C. Bone."
3. "Piedmont Royal Ammoniated Bone and Potash."
4. "Piedmont Soluble Bone and Potash."
5. "Piedmont Pure Raw Bone Mixture."
6. "Levering's Harvest Queen."
7. "Levering's I. X. L. Phosphate."
8. "Diamond (S) Soluble Bone."

PITTSBURG PROVISION CO., Pittsburg, Pa.

1. "No. 1 Pure Raw Bone Meal."
2. "Pure Raw Bone Meal."
3. "Crescent Butchers' Ground Bone."
4. "Pure Bone with Potash."
5. "Corn and Potato Fertilizer."
6. "Keystone Fertilizer."
7. "Guano Fertilizer."
8. "Acid Phosphate."
9. "Phosphate and Potash."

POLLOCK, R. H., No. 51 S. Gay Street, Baltimore, Md.

1. "Dissolved S. C. Bone."
2. "Victor Bone Phosphate."
3. "Superior Corn and Tomato Fertilizer."
4. "Owl Brand Guano."
5. "Special Potato and Tobacco Fertilizer."
6. "Special Wheat Grower."
7. "Ammoniated Bone Phosphate."
8. "Soft Ground Bone."

POWELL, W. S., & Co., No. 306 Water Street, Baltimore, Md.

1. "Dissolved S. C. Bone."

PUGH & LYON, Oxford, Pa.

1. "Ground Raw Bone."
2. "Bone Phosphate."

RAMSBURG FERTILIZER COMPANY, Frederick, Md.

1. "Excelsior Plant Food."
2. "Old Virginia Compound."
3. "Ammoniated Bone Phosphate."
4. "Alkaline Phosphate."
5. "Dissolved Bone Super-Phosphate."

RASIN-MONUMENTAL COMPANY, No. 300 Water Street, Baltimore, Md.

1. "Rasin's Empire Guano."
2. "Rasin's Ammoniated Super-Phosphate."
3. "Rasin's Bone and Potash Fertilizer."
4. "Rasin's Acid Phosphate."
5. "Monumental Soluble Bone Phosphate and Potash."
6. "Monumental Acid Phosphate."
7. "Monumental William Penn Crop Grower."
8. "Monumental Potato Manure."
9. "Rasin's I. X. L. Fertilizer."
10. "Special Formula for Corn and Buckwheat."
11. "Rasin Dissolved Bone."
12. "Arundel Complete."

RAUH, E., & SONS CO., No. 419 S. Penn Street, Indianapolis, Ind.

1. "Dissolved Bone and Potash."
2. "Soluble Bone."
3. "Acidulated Bone."
4. "Ideal Phosphate."

READING CHEMICAL AND FERTILIZING CO., LIM., Reading, Pa.

1. "Potato and Vegetable Brand."
2. "Neversink Brand."
3. "A. A. Brand."
4. "Mt. Penn Brand."
5. "Reading Star Brand."
6. "Bone Meal."

REESE, JACOB, No. 400 Chestnut Street, Philadelphia, Pa.

1. "Odorless Slag Phosphate."

RICE, HAMPTON, Lumberville, Pa.

1. "W. Kenderdine's A. A. Phosphate."
2. "W. Kenderdine's A. B. Phosphate."
3. "W. Kenderdine's Potato Phosphate."
4. "No. 3 Phosphate."

RIVERSIDE ACID PHOSPHATE, Warren, Pa.

1. "Harvest Moon Phosphate."
2. "Richacre Phosphate."
3. "Old Gold Phosphate."
4. "Phosphate and Potash."

RUSSELL AGRICULTURAL CHEMICAL CO., THE, Newark, N. J.

1. "Ten Per Cent. Phosphate."
2. "Special Potato."
3. "Harvest Queen."
4. "Champion."

SALE, GEORGE F., (Sandiford), Philadelphia, Pa.

1. "Geo. F. Sale's Special Manure for all Crops."

SCHAAL-SHELDON FERTILIZER CO., Erie, Pa.

1. "Sheldon's Empire."
2. "Sheldon's Farmers' Favorite."
3. "Schaal's Standard."
4. "Sheldon's Grass, Grain and Potato."
5. "Sheldon's Truckers' Manure."
6. "Schaal's Corn and Potato."
7. "Sheldon's Guano."
8. "Pure Bone Meal."
9. "Dissolved Bone and Extra Potash."
10. "Dissolved Bone and Potash."
11. "Dissolved Bone."

SCIENTIFIC FERTILIZER CO., THE, Pittsburg, Pa.

1. "Scientific Corn and Grain Fertilizer."
2. "Scientific Economy."
3. "Scientific Bone, Meat and Potash Fertilizer."
4. "Scientific Potato Fertilizer."
5. "Scientific Dissolved Bone Fertilizer."
6. "Scientific Phosphate and Potash Fertilizer."
7. "Bone and Meat."
8. "Pure Raw Bone Meal."
9. "High Grade Acid Phosphate."

SCOTT FERTILIZER CO., THE, Elkton, Pa.

1. "Sure Growth Phosphate."
2. "Standard Phosphate."
3. "Elk Head Super-Phosphate."
4. "Corn and Oats Grower."
5. "Tip Top Soluble Bone."
6. "Scott's Tobacco Grower."
7. "Tip Top Soluble Bone and Potash."
8. "Scott's Potato Grower."
9. "Potato, Truck and Tobacco Grower."

SHENANDOAH FERTILIZER COMPANY, Shenandoah, Pa.

1. "Shenandoah Brand."
2. "Standard Potash Brand."
3. "Ringtown Clover."
4. "Gold Eagle."
5. "N. & S. Complete Clover."
6. "Special Wheat."
7. "Chemical Bone Phosphate."

SHOEMAKER, M. L., & CO., Cor. Delaware Avenue and Venango Streets, Philadelphia, Pa.

1. "Swift Sure Phosphate for General Use."
2. "Swift Sure Phosphate for Potatoes."
3. "Swift Sure Phosphate for Tobacco."
4. "Swift Sure Special 10 Per Cent. Potato Fertilizer No. 1."
5. "Swift Sure Special 10 Per Cent. Potato Fertilizer No. 2.
6. "Swift Sure Guano for Tomatoes, Truck and Corn."
7. "Swift Sure Guano for Fall Trade."
8. "Swift Sure New Jersey Special for Oats."
9. "Swift Sure New Jersey Special for Wheat and Clover."
10. "Swift Sure Bone Meal."
11. "Swift Sure Dissolved Bone."
12. "Good Enough Phosphate."
13. "Echo Phosphate."
14. "Twenty-three Dollar Phosphate."
15. "Dissolved S. C. Rock."
16. "Pure Raw Bone Meal."

SICKLER, CHAS. A., & BRO., Wilkes-Barre, Pa.

1. "Special Potato and Vegetable Manure."
2. "Vegetable and Vine Fertilizer."
3. "Empire Phosphate."
4. "King Phosphate."
5. "Monarch Phosphate."
6. "Pure Ground Bone."
7. "Graves Potato Manure."

SIMON, F. A., Maud P. O., Pa.

1. "Truck and Corn."
2. "Potato Grade."
3. "General Use."

SLAGLE, E. A., Paxinos, Pa.

1. "Xtra Bone Phosphate."
2. "Plant Food."
3. "Crop Grower."
4. "Dissolved Bone."

SMYSER, H. H., York, Pa.

1. "Chicago Soluble Bone."
2. "Chicago Crop Grower."
3. "Chicago Bone and Tankage."
4. "Chicago Bone and Potash."

SONDER, PETER, & CO., Morwood, Pa.

1. "Sonder's Fertilizer."

SOUTHERN FERTILIZER COMPANY, York, Pa.

1. "Ox Brand Ammoniated Dissolved Bone."

2. "Ox Brand Special Potato Grower."
3. "Ox Brand General Crop Grower."
4. "Ox Brand Farmers' Choice Brand."
5. "Ox Brand Dissolved Bone Phosphate."
6. "Ox Brand Soluble Bone and Potash."
7. "Ox Brand Queen of the Harvest."
8. "Ox Brand Pure Ground Bone."
9. "Royal Wheat and Grass Grower."
10. "Gardeners' and Truckers' Delight."

STERNER, E. H., Codorus, Pa.

1. "Sterner's Dissolved Bone Phosphate."

STICK, H. S., Glenville, Pa.

1. "Stick's York County Phosphate."
2. "Stick's Peruvian Phosphate."
3. "Stick's Dissolved S. C. Phosphate."

STONER, E. B., Hellam, Pa.

1. "Stoner's Wheat and Grass Fertilizer."

STRAINING, JOHN E., No. 1752 N. Cameron Street, Harrisburg, Pa.

SWIFT & COMPANY, Union Stock Yards, Chicago, Ill.

1. "Swift's Super-Phosphate."
2. "Swift's Garden City Phosphate."
3. "Swift's Complete Fertilizer."
4. "Swift's Ammoniated Bone and Potasn."
5. "Swift's Bone and Potash."
6. "Swift's Raw Bone Meal."
7. "Swift's Bone Meal."
8. "Swift's Diamond (S) Phosphate."
9. "Swift's Potato and Tobacco Grower."
10. "Swift's Onion and Potato Special."
11. "Swift's Pure Steamed Bone."
12. "Swift's Raw Ground Bone."
13. "Swift's Special Bone Meal."
14. "Swift's Champion Wheat Grower."

TAYLOR PROVISION COMPANY, THE, Trenton, N. J.

1. "Special Potato."
2. "Corn and Truck."
3. "Ammoniated Dissolved Bone."

TEMPIN, J. M., Honeybrook, Pa.

1. "No. 5. High Grade Acid Phosphate."
2. "No. 3. Farmers' Complete Fertilizer."
3. "No. 16. Cereal Fertilizer."
4. "No. 4. Atlas Brand."
5. "No. 8. High Grade Potash Manure."

THOMAS, HAINES & CO., Malvern, Pa.

1. "New Century Crop Grower."

THOMAS, JAMES, Williamsport, Pa.

1. "Thomas' High Grade Bone Super-Phosphate."
2. "Thomas' Klondyke Brand."
3. "Thomas' Dissolved Soluble Bone and Potash Phosphate."
4. "Thomas' High Grade Potato and Tobacco Manure."
5. "Thomas' Special Compound."
6. "Thomas' Standard Bone Phosphate."
7. "Thomas' Pure Dissolved Soluble Bone Phosphate."

THOMAS, I. P., & SONS CO., No. 2 S. Delaware Avenue, Philadelphia, Pa.

1. "S. C. Phosphate."
2. "Farmers' Choice Bone Phosphate."
3. "Normal Bone Phosphate."
4. "Improved Super-Phosphate."
5. "Special Corn Fertilizer."
6. "Alkaline Bone."
7. "Special Alkaline Bone."
8. "Dissolved Phosphate."
9. "Tip Top Raw Bone Super-Phosphate."
10. "Pure Ground Animal Bone."
11. "Potato Fertilizer."
12. "Champion Bone Phosphate."
13. "Raw and Acidulated Bone."
14. "Superior Super-Phosphate."

TOMLINSON, WATSON, JR., (Torresdale), Philadelphia, Pa.

1. "Tomlinson's Potato Fertilizer and Crop Feeder."

TRENTON BONE FERTILIZER CO., Trenton, N. J.

1. "Trenton Super-Phosphate."
2. "Trenton Corn Mixture."
3. "Trenton $32.00 Potato Manure."
4. "Trenton Potato Manure."

TRINLEY, JACOB, Linfield, Pa.

1. "Pure Raw Bone Meal."
2. "Pure Raw Bone Super-Phosphate."
3. "Grain and Grass Grower."
4. "Ravene Bone Phosphate."
5. "Soluble Bone and Potash."

TUSCARORA FERTILIZER COMPANY, THE, Port Royal, Pa.

1. "Ammoniated Phosphate."
2. "Pennsylvania Standard."
3. "Big (4) Four."
4. "Animal Bone."
5. "Bone and Potash."

6. "Tuscarora Bone."
7. "Acid Phosphate."

TUSTIN, I. J. Phoenixville, Pa.

1. "Pickering Valley Special for Potatoes."
   "Pickering Valley Special."
   "Pickering Valley High Grade."

TYGERT, THE, J. E. COMPANY, No. 42 S. Delaware Avenue, Philadelphia, Pa.

1. "Bone Phosphate."
2. "Ground Bone."
3. "Soluble Bone and Potash."
4. "Potato Guano."
5. "Ammoniated Super-Phosphate."
6. "Popular Phosphate."
7. "Golden Harvest Phosphate."

ULMER, JACOB, PACKING COMPANY, Pottsville, Pa.

1. "Ulmer's Blood, Meat and Bone Super-Phosphate."

UNIONTOWN FERTILIZER WORKS, Uniontown, Pa.

1. "Fell's Pure Ground Bone."
2. "Fell's Gold Premium Bone Phosphate."
3. "Fell's High Grade Acid Phosphate."

WAHL, EMIL, MANF'G CO., Nos. 3970-3986 Pulaski Avenue (Nicetown), Philadelphia, Pa.

1. "Emil Wahl's Warranted Pure Philadelphia Button Bone Dust."

WALKER, STRATMAN & COMPANY, Pittsburg, Pa.

1. "Four Fold."
2. "Grain King."
3. "Big Bonanza."
4. "Potato Special."
5. "Meat, Blood and Bone with Potash."
6. "Help Mate."
7. "Phosphoric Acid and Potash."
8. "Bone and Meat."
9. "Pure Raw Bone Meal."
10. "Acid Phosphate."

WALKER, J. C., & SON, Gap, Pa.

1. "Pride of Pequa."
2. "Pride of Pequa, High Grade."

WALT, F. K., & CO., Supplee P. O., Penna.

1. "Farmers' Union."

WAMBAUGH, LEVI, Parke P. O., Pa.

1. "Wambaugh's Mixture, Gathered from Slaughter Shops."

WHANN, W. E., William Penn P. O., Pa.

1. "Chester Valley Special Potato and Truck Fertilizer."
2. "Chester Valley Raw Bone Super-Phosphate."
3. "Chester Valley Fish and Potash Fertilizer."
4. "Chester Valley Ammoniated Super-Phosphate."
5. "Chester Valley No. 2 Ammoniated Super-Phosphate."
6. "Chester Valley Special Ammoniated Super-Phosphate."
7. "Soluble Bone and Potash."
8. "Chester Valley Available Ammoniated Super-Phosphate."
9. "South Carolina Phosphate."
10. "Pure Ground Raw Bone."
11. "Celery Mixture."

WHANN, JOHN, & SON, No. 28 S. Delaware Avenue, Philadelphia, Pa.

1. "Our Brand Raw Bone Phosphate."
2. "A. A. Acid Phosphate."
3. "J. W. & S. Special Mixture."
4. "Wheat and Grass Mixture."
5. "Pure Ground Bone."
6. "Reliable Ammoniated Super-Phosphate."

WINDLE, DOAN & CO., Coatesville, Pa.

1. "Ground Bone."
2. "Cook's Bone Phosphate."
3. "Ammoniated Bone Phosphate."

WOOLDRIDGE, THE R. A., COMPANY, No. 33 S. Gay Street, Baltimore, Md.

1. "Florida Acid Phosphate."
2. "German Potash Mixture."
3. "Liberty Bell Potash Mixture."
4. "Old Sledge Phosphate."
5. "Champion Giant Phosphate."
6. "Chieftain Bone Stock Phosphate."
7. "Triumph Pure Bone Phosphate."
8. "Special Potato Fertilizer."
9. "Tuckahoe Bone Meal."
10. "Buffalo Bone Stock Phosphate."
11. "Pure Raw Bone."

YORK CHEMICAL COMPANY, York, Pa.

1. "Ammoniated Raw Bone Fertilizer."
2. "Dissolved Phosphate."
3. "Black Cross Phosphate."
4. "Red Cross Phosphate."
5. "New York Fertilizer."

6. "Prosperity Ammoniated Bone and Potash Fertilizer."
7. "Blue Cross Phosphate."
8. "Potato and Tobacco."

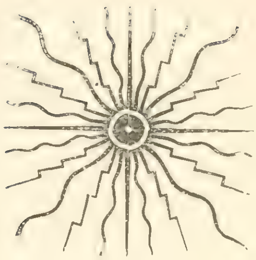
ZEIGLER, E. H., & CO., Stewartstown, Pa.

1. "Bone Phosphate."
2. "Potato Phosphate."
3. "Zeigler's Mixture."
4. "Zeigler's Crop Grower."

ZOOK, HENRY, S., Elverson, Pa.

1. "No. 7. Pride of Chester Dissolved Animal Bone Phosphate for General Use.
2. "No. 6. Pride of Chester Dissolved Animal Bone Phosphate."
3. "No. 5. Pride of Chester Corn, Oats and Wheat Fertilizer."
4. "Zook's Clear Acid Phosphate."

APPENDIX.



APPENDIX.

LIST OF PUBLICATIONS OF THE PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

ANNUAL REPORTS.

*Report of the State Board of Agriculture, 336 pages, 1877.
*Report of the State Board of Agriculture, 625 pages, 1878.
*Report of the State Board of Agriculture, 560 pages, 1879.
*Report of the State Board of Agriculture, 557 pages, 1880.
*Report of the State Board of Agriculture, 646 pages, 1881.
*Report of the State Board of Agriculture, 645 pages, 1882.
*Report of the State Board of Agriculture, 645 pages, 1883.
*Report of the State Board of Agriculture, 648 pages, 1884.
*Report of the State Board of Agriculture, 645 pages, 1885.
*Report of the State Board of Agriculture, 646 pages, 1886.
*Report of the State Board of Agriculture, 650 pages, 1887.
*Report of the State Board of Agriculture, 648 pages, 1888.
*Report of the State Board of Agriculture, 650 pages, 1889.
*Report of the State Board of Agriculture, 594 pages, 1890.
*Report of the State Board of Agriculture, 600 pages, 1891.
*Report of the State Board of Agriculture, 604 pages, 1892.
*Report of the State Board of Agriculture, 713 pages, 1893.
*Report of the State Board of Agriculture, 646 pages, 1894.
*Report of the Department of Agriculture, 878 pages, 1895.
Report of the Department of Agriculture, Part 1, 820 pages, 1896.
Report of the Department of Agriculture, Part 2, 444 pages, 1896.
*Report of the Department of Agriculture, Part 1, 897 pages, 1897.
*Report of the Department of Agriculture, Part 2, 309 pages, 1897.
Report of the Department of Agriculture, 894 pages, 1898.
Report of the Department of Agriculture, Part 1, 1082 pages, 1899.
Report of the Department of Agriculture, Part 2, 368 pages, 1899.
Report of the Department of Agriculture, Part 1, 1010 pages, 1900.
Report of the Department of Agriculture, Part 2, 348 pages, 1900.
Report of the Department of Agriculture, Part 1, —pages, 1901.
Report of the Department of Agriculture, Part 2, — pages, 1901.

*Note.—Edition exhausted.

BULLETINS.

No. 1.* Tabulated Analyses of Commercial Fertilizers, 24 pages, 1895.

No. 2.* List of Lecturers of Farmers' Institutes, 36 pages, 1895.

No. 3.* The Pure Food Question in Pennsylvania, 38 pages, 1895.

No. 4.* Tabulated Analyses of Commercial Fertilizers, 22 pages, 1896.

No. 5.* Tabulated Analyses of Commercial Fertilizers, 38 pages, 1896.

No. 6.* Taxidermy; how to Collect Skins, etc., 128 pages, 1896.

No. 7.* List of Creameries in Pennsylvania, 68 pages, 1896.

No. 8.* Report of State Horticultural Association, 108 pages, 1896.

No. 9.* Report of Dairymen's Association, 96 pages, 1896.

No. 10.* Prepared Food for Invalids and Infants, 12 pages, 1896.

No. 11.* Tabulated Analyses of Commercial Fertilizers, 22 pages, 1896.

No. 12.* Road Laws for Pennsylvania, 42 pages, 1896.

No. 13.* Report of Butter Colors, 8 pages, 1896.

No. 14.* Farmers' Institutes in Pennsylvania, 92 pages, 1890.

No. 15. Good Roads for Pennsylvania, 42 pages, 1896.

No. 16. Dairy Feeding as Practiced in Pennsylvania, 126 pages, 1896.

No. 17.* Diseases and Enemies of Poultry, 128 pages, 1896.

No. 18.* Digest of the General and Special Road Laws for Pennsylvania, 130 pages, 1896.

No. 19. Tabulated Analyses of Commercial Fertilizers, 40 pages, 1896.

No. 20.* Preliminary Report of Secretary, 126 pages, 1896.

No. 21. The Township High School, 24 pages, 1897.

No. 22.* Cider Vinegar of Pennsylvania, 28 pages, 1897.

No. 23.* Tabulated Analyses of Commercial Fertilizers, 31 pages, 1897.

No. 24.* Pure Food and Dairy Laws of Pennsylvania, 19 pages, 1897.

No. 25.* Farmers' Institutes in Pennsylvania, 8 pages, 1897.

No. 26. Farmers' Institutes in Pennsylvania, 74 pages, 1897.

No. 27. The Cultivation of American Ginseng, 23 pages, 1897.

No. 28. The Fungous Foes of the Farmer, 19 pages, 1897.

No. 29. Investigations in the Bark of the Tree, 17 pages, 1897.

*Note.—Edition exhausted.

No. 30. Sex in Plants, 17 pages, 1897.

No. 31. The Economic Side of the Mole, 42 pages, 1898.

No. 32.* Pure Food and Dairy Laws, 30 pages, 1898.

No. 33.* Tabulated Analyses of Commercial Fertilizers, 42 pages, 1898.

No. 34.* Preliminary Report of the Secretary, 150 pages, 1898.

No. 35. Veterinary Medicines, 23 pages, 1898.

No. 36.* Constitutions and By-Laws, 72 pages, 1898.

No. 37.* Tabulated Analyses of Commercial Fertilizers, 40 pages, 1898.

No. 38.* Farmers' Institutes in Pennsylvania, 8 pages, 1898.

No. 39.* Farmers' Institutes in Pennsylvania, 88 pages, 1898.

No. 40. Questions and Answers, 206 pages, 1898.

No. 41.* Preliminary Reports of the Department, 189 pages, 1899.

No. 42.* List of Creameries in Pennsylvania, 88 pages, 1899.

No. 43. The San José Scale and other Scale Insects, 22 pages, 1899.

No. 44. Tabulated Analyses of Commercial Fertilizers, 62 pages, 1899.

No. 45. Some Harmful Household Insects, 13 pages, 1899.

No. 46. Some Insects Injurious to Wheat, 24 pages, 1899.

No. 47. Some Insects Attacking Fruit, etc., 19 pages, 1899.

No. 48. Common Cabbage Insects, 14 pages, 1899.

No. 49. Method of Protecting Crops, etc., 20 pages, 1899.

No. 50. Pure Food and Dairy Laws of Pennsylvania, 33 pages, 1899.

No. 51. Tabulated Analyses of Commercial Fertilizers, 69 pages, 1899.

No. 52.* Proceedings Spring Meeting of Board of Agriculture, 296 pages, 1899.

No. 53. Farmers' Institutes in Pennsylvania, 1899-1900, 94 pages, 1899.

No. 54. Tabulated Analyses of Commercial Fertilizers, 163 pages, 1899.

No. 55. The Composition and Use of Fertilizers, 126 pages, 1899.

No. 56. Nursery Fumigation and the Construction and Management of the Fumigating House, 24 pages, 1899.

No. 57. The Application of Acetylene Illumination to Country Homes, 85 pages, 1899.

No. 58. The Chemical Study of the Apple and Its Products, 44 pages, 1899.

No. 59. Fungous Foes of Vegetable Fruits, 39 pages, 1899.

No. 60.* List of Creameries in Pennsylvania, 33 pages, 1899.

No. 61. The Use of Lime on Pennsylvania Soils, 170 pages, 1900.

*Note.—Edition exhausted.

No. 62. A Summer's Work Abroad in School Grounds, Home Grounds, Play Grounds, Parks and Forests, 34 pages, 1900.

No. 63. A Course in Nature Study for Use in the Public Schools, 119 pages, 1900.

No. 64. Nature Study Reference Library for Use in the Public Schools, 22 pages, 1900.

No. 65. Farmers' Library List, 29 pages, 1900.

No. 66. Pennsylvania Road Statistics, 98 pages, 1900.

No. 67. Methods of Steer Feeding, 14 pages, 1900.

No. 68. Farmers' Institutes in Pennsylvania, 90 pages, 1900.

No. 69. Road Making Materials of Pennsylvania, 104 pages, 1900.

No. 70. Tabulated Analyses of Commercial Fertilizers, 97 pages, 1900.

No. 71. Consolidation of Country Schools and the Transportation of the Scholars by Use of Vans, 89 pages, 1900.

No. 72. Tabulated Analyses of Commercial Fertilizers, 170 pages, 1900.

No. 73. Synopsis of the Tax Laws of Pennsylvania, 132 pages, 1901.

No. 74. The Repression of Tuberculosis of Cattle by Sanitation, 24 pages, 1901.

No. 75. Tuberculosis of Cattle, and the Pennsylvania Plan for its Repression, 262 pages, 1901.

No. 76. A Co-operative Investigation into the Agricultural Seed Supply of Pennsylvania, 50 pages, 1901.

No. 77. Bee Culture, 101 pages, 1901.

No. 78. List of County and Local Agricultural Societies, 10 pages, 1901.

No. 79. Rabies, 28 pages, 1901.

No. 80. Decisions of the Department of Agriculture on the Pure Food Act of 1895, 20 pages, 1901.

No. 81. Concentrated Commercial Feeding Stuffs in Pennsylvania, 136 pages, 1901.

No. 82. Containing the Law Creating a Department of Agriculture in Pennsylvania, and Giving the Various Acts of Assembly Committed to the Department for Enforcement; Together with Decisions and Standards Adopted with Reference to the Pure Food Act of 1895. 90 pages, 1901.

No. 83. Tabulated Analyses of Commercial Fertilizers, 132 pages, 1901.

No. 84. Methods of Steer Feeding, the Second Year of Co-operative Experiment by the Pennsylvania State Department of Agriculture and the Pennsylvania State College Agricultural Experiment Station, 16 pages, 1901.

No. 85. Farmers' Institutes of Pennsylvania, 102 pages, 1901.

No. 86. Containing a Complete List of Licenses granted by the Dairy and Food Commissioner, from January 1, 1901, to July 1, 1901, etc., 422 pages, 1901.

No. 87. Giving Average Composition of Feeding Stuffs, 42 pages, 1901.

No. 88. List of Creameries in Pennsylvania, 33 pages, 1901.

No. 89. Tabulated Analyses of Commercial Fertilizers, 195 pages, 1901.

CROP REPORT FOR 1901.

Giving Prices of Farm Products and Live Stock, with Farm Wages and Board, in Pennsylvania by Counties. Collected by A. L. Martin, Deputy Secretary of Agriculture.

Counties.	Wheat. (Bushel)	Corn. (Bushel)	Oats. (Bushel)	Rye. (Bushel)	Buckwheat. (Bushel)	Hay, clover. (Ton)	Hay, timothy. (Ton)	Horses, average.	Mules, average.	Cows, average.	Lambs, average.	Ewes, average.	Steers, fat, per lb.	Steers for feeding, per lb.	Swine, shoats, per lb.	Fat hogs, per lb.	Chickens, dressed, per lb.	Chickens, live, per pound.
Adams,	[illegible]	[illegible]	[illegible]	$0 46	[illegible]	[illegible]	$11 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ 1[illegible]	[illegible]
Allegheny,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2 13	3 3[illegible]	05	04	06	06	1[illegible]	[illegible]
Armstrong,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12[illegible] 00	[illegible]	[illegible] 41	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	[illegible]
Beaver,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 00	13 7[illegible]	[illegible]	....	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	0[illegible]
Bedford,	72	[illegible]	42	[illegible]	[illegible]	8 [illegible]	11 [illegible]	[illegible]	120 00	[illegible]	[illegible]	[illegible]	04	[illegible]	[illegible]	[illegible]	10	[illegible]
Berks,	71	60	30	58	....	13 00	15 25	80 00	88 00	30 00	....	....	05	04	07	[illegible]	12	1[illegible]
Blair,	75	66	50	65	65	11 00	14 00	93 00	92 00	26 00	3 83	4 38	05	04	07	06	13	09
Bradford,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 50	90 00	73 00	20 00	3 10	2 75	04½	04	05	05	10	08
Bucks,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	173 00	[illegible]	[illegible]	4 00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9
Butler,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11 [illegible]	[illegible]	90 00	[illegible]	3 10	[illegible] 25	04½	03	06	[illegible]	[illegible]	[illegible]
Cambria,	[illegible]	[illegible]	[illegible]	71	[illegible]	[illegible]	16 00	[illegible]	90 00	[illegible]	[illegible]	[illegible]	04½	03	05	[illegible]	[illegible]	11
Cameron,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 00	11 00	80 00	....	[illegible]	[illegible]	3 00	[illegible]	....	05	[illegible]	12	10
Carbon,	78	[illegible]	[illegible]	60	[illegible]	[illegible]	16 50	[illegible]	100 00	[illegible]	[illegible]	5 00	[illegible]	03½	08	[illegible]	13	11
Centre,	[illegible]	[illegible]	[illegible]	48	[illegible]	10 00	12 25	[illegible]	110 00	[illegible]	[illegible]	[illegible]	04	03	[illegible]	[illegible]	[illegible]	06
Chester,	[illegible]	[illegible]	[illegible]	53	65	[illegible]	[illegible]	136 00	125 00	[illegible]	4 25	[illegible] 50	04½	04	08	[illegible]	13	11
Clarion,	67	[illegible]	45	[illegible]	50	9 00	10 50	105 00	100 00	[illegible]	[illegible]	2 75	04	03	05	[illegible]	[illegible]	[illegible]
Clearfield,	[illegible]	60	46	[illegible]	[illegible]	11 00	13 50	[illegible]	....	[illegible]	2 50	2 75	07	....	....	07	14	07
Clinton,	74	[illegible]	[illegible]	65	50	[illegible]	12 50	125 [illegible]	41 00	3[illegible] 00	[illegible]	[illegible]	04½	03½	[illegible]	07½	[illegible]	[illegible]
Columbia,	[illegible]	56	[illegible]	53	51	[illegible]	[illegible]	[illegible]	120 00	[illegible]	[illegible]	[illegible]	[illegible]	04	05	06	[illegible]	09
Crawford,	[illegible]	62	[illegible]	[illegible]	50	6 50	8 50	67 00	....	[illegible]	[illegible]	[illegible]	03½	02½	05½	05½	10	07
Cumberland,	[illegible]	[illegible]	[illegible]	[illegible]	....	10 50	13 50	72 00	100 00	[illegible]	[illegible]	[illegible] 25	[illegible]	04	07	07	15	[illegible]
Dauphin,	[illegible]	57	41	[illegible]	45	12 12	14 75	93 00	115 00	[illegible]	....	....	[illegible]	04	08	09	[illegible]	08
Delaware,	[illegible]	[illegible]	....	....	....	11 [illegible]	[illegible]	125 00	....	[illegible]	....	....	....	....	....	....	16	12

Elk,	78	57	41	63	62	13 75	16 81	78 00	....	33 00	3 75	3 30	05	....	....	....	15	10
Erie,	74	61	39	51	50	9 00	10 75	85 00	....	32 00	3 00	3 25	04	03	05½	06	11	08
Fayette,	66	66	46	65	75	13 33	15 33	125 00	150 00	37 00	2 83	3 00	04	04	05	06	10	07
Forest,	80	47	40	66	48	11 33	12 33	100 00	....	28 00	2 50	3 16	01	03	08	05	10	07
Franklin,	66	53	35	51	55	9 25	12 00	100 00	90 00	32 00	2 38	4 50	04¾	04¾	08	06	10	08
Fulton,	65	55	34	52	55	9 37	11 60	92 00	75 00	29 00	2 68	3 25	04	03	05½	06	09	07
Greene,	71	52	33	60	75	9 00	11 83	103 00	95 00	31 00	1 50	2 33	04	03	05	06	10	07
Huntingdon,	42	60	33	58	55	11 50	11 00	86 00	109 00	21 00	3 33	2 80	04	03	03	07	12	08
Indiana,	60	70	45	50	50	....	11 00	100 00	60 00	20 00	3 00	3 50	05	01	05	06	....	06
Jefferson,	72	55	43	60	54	10 00	12 00	87 00	....	29 00	2 38	2 50	04	03	05	06	12	08
Juniata,	66	52	35	58	48	10 00	12 00	96 00	106 00	33 00	3 16	3 50	04	04	06	08	09	[illegible]
Lackawanna,	[illegible]	76	50	78	50	13 50	15 50	125 00	127 00	[illegible]	[illegible]	3 00	04	02	05	06	14	[illegible]
Lancaster,	[illegible]	53	35	54	....	[illegible]	[illegible]	105 00	[illegible]	[illegible]	[illegible]	[illegible]	05	04	[illegible]	[illegible]	[illegible]	[illegible]
Lawrence,	[illegible]	[illegible]	37	77	52	[illegible]	[illegible]	[illegible]	....	[illegible]	[illegible]	[illegible]	04	04	[illegible]	[illegible]	12	[illegible]
Lebanon,	[illegible]	63	40	57	....	[illegible]	[illegible]	[illegible]	120 00	[illegible]	....	....	[illegible]	04	[illegible]	[illegible]	12	[illegible]
Lehigh,	[illegible]	57	39	54	[illegible]	[illegible]	[illegible]	117 00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	04	[illegible]	[illegible]	[illegible]	[illegible]
Luzerne,	75	61	40	56	51	13 00	17 00	103 00	110 00	34 00	3 16	3 33	06	01	[illegible]	[illegible]	[illegible]	[illegible]
Lycoming,	71	61	44	55	51	9 50	11 75	116 00	....	31 00	3 20	3 62	05	03	06	07	13	[illegible]
McKean,	78	62	50	75	63	11 66	12 33	150 00	....	26 00	2 30	2 33	01	03	04	06	12	08
Mercer,	68	62	32	57	49	8 50	10 50	94 00	65 00	24 00	3 00	2 81	04	04	05	05	11	07
Mifflin,	64	54	33	51	60	12 00	13 75	87 00	55 00	32 00	3 25	3 50	05	01	06	06	10	07
Monroe,	74	62	42	61	51	12 00	15 00	104 00	100 00	32 00	3 25	2 87	04	03	07	07	12	09
Montgomery,	[illegible]	[illegible]	42	75	....	10 00	13 00	108 00	150 00	42 00	4 00	4 00	05	04	08	08	14	10
Montour,	72	58	39	51	50	10 00	13 50	77 00	50 00	31 00	3 00	4 00	05	04	05	[illegible]	12	[illegible]
Northampton,	74	55	35	62	56	12 20	15 60	94 00	112 00	19 00	4 00	4 10	05	04	07	08	13	09
Northumberland,	70	62	42	55	50	11 37	14 80	90 00	93 00	24 00	3 25	4 25	06	04	05	07	12	10
Perry,	68	58	40	52	49	9 60	12 50	85 00	100 00	30 00	2 80	4 22	05	04	07	08	10	[illegible]
Philadelphia,	70	75	38	55	55	17 50	19 00	100 00	....	15 00	2 50	3 50	06	....	10	10	12	10
Pike,	82	63	45	61	49	10 33	13 66	96 00	100 00	29 00	4 16	4 33	05	04	06	05	12	10
Potter,	....	60	50	46	....	9 33	10 66	78 00	....	23 00	2 06	2 66	06	....	05	06	12	06
Schuylkill,	[illegible]	68	45	[illegible]	53	12 33	16 33	87 00	105 00	[illegible]	[illegible]	....	07	04	08	07	13	10
Snyder,	[illegible]	[illegible]	[illegible]	50	49	11 50	11 00	[illegible]	90 00	[illegible]	[illegible]	[illegible]	05	04	[illegible]	[illegible]	11	[illegible]
Somerset,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 00	13 66	108 00	147 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12	[illegible]
Sullivan,	[illegible]	50	50	56	50	12 00	12 00	60 00	....	[illegible]	[illegible]	[illegible]	04	04	[illegible]	[illegible]	....	....
Susquehanna,	[illegible]	65	50	60	55	10 00	12 00	100 00	....	[illegible]	[illegible]	[illegible]	04	....	[illegible]	[illegible]	12	[illegible]
Tioga,	77	74	50	70	65	6 50	10 00	88 00	87 00	[illegible]	[illegible]	[illegible]	04	[illegible]	[illegible]	[illegible]	11	[illegible]
Union,	[illegible]	[illegible]	[illegible]	52	50	[illegible]	[illegible]	84 00	83 00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	04	[illegible]	11	[illegible]
Venango,	76	57	39	55	55	9 50	12 00	92 00	93 00	[illegible]	[illegible]	2 68	04	03	05	06	11	07
Warren,	75	56	41	70	56	10 00	12 00	125 00	100 00	[illegible]	3 00	2 83	04	03	05	05	11	08
Washington,	65	59	39	....	....	10 25	12 25	100 00	....	36 00	3 00	3 00	05	04	07	06	13	[illegible]
Wayne,	....	53	46	80	51	8 00	10 00	104 00	....	30 00	3 50	3 50	05	03	06	06	12	[illegible]
Westmoreland,	[illegible]	[illegible]	[illegible]	78	42	[illegible]	13 66	100 00	90 00	25 00	2 28	4 00	05	04	06	07	11	08
Wyoming,	[illegible]	[illegible]	42	56	49	10 50	13 00	100 00	100 00	[illegible]	[illegible]	[illegible]	[illegible]	02	[illegible]	[illegible]	11	[illegible]
York,	[illegible]	[illegible]	38	47	[illegible]	10 00	13 25	81 00	102 00	[illegible]	[illegible]	[illegible]	04	03	[illegible]	[illegible]	11	[illegible]
Total,	[illegible]	[illegible]	$0 41	$0 58	[illegible]	$10 81	$12 30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CROP REPORT FOR 1901—Continued.

Vegetables, Fruit, Etc.

Counties	Apples, per bushel.	Peaches, per basket.	Pears, per bushel.	Plums, per quart.	Cherries, per quart.	Blackberries, per quart.	Raspberries, per quart.	Potatoes, per bushel.	Butter, per lb., at store.	Butter, per lb., at market.	Milk, wholesale, 100 lbs.	Milk, retail, per quart.	Eggs, per dozen.
Adams,	$0 60	$0 46	$0 77	$0 05 3-5	$0 05	$0 05	$0 05 3-5	$0 78	$0 16	$0 18	$0 67	$0 05	$0 17
Allegheny,	66	85	1 08	10	09	08	09	1 08	21	26	1 10	06 1-3	22
Armstrong,	42	63	1 12	05	06	09	09	85	18	22	....	05½	17
Beaver,	56	63	75	07	09	06	05	62	20	26	88	[illegible]	17
Bedford,	62	50	63	03	06	06	08	88	20	26	....	05	18
Berks,	77	75	86	10	06	07	10	92	19	24	87	05	18
Blair,	66	80	1 00	09	08	08	09	73	26	28	1 06	07	18
Bradford,	78	96	78	04	06	08	09	49	20	19	1 11	04	18
Bucks,	76	85	80	07	06	08	09	65	24	28	1 12	07	19
Butler,	80	50	1 10	07	05	05	07	90	18	21	90	06	21
Cambria,	1 20	95	1 31	08	09	08	10	88	22	25	....	06	21
Cameron,	....	60	....	12	08	09	10	1 00	25	20	....	06	25
Carbon,	80	85	87	05	06	08	09	75	23	24	1 75	06	18
Centre,	70	70	75	06	06	06	06	61	17	16	1 00	05	14
Chester,	1 00	75	1 00	06	07	08	10	68	23	26	1 07	06	19
Clarion,	70	50	1 00	10	07	06	10	81	18	23	1 25	05	14
Clearfield,	1 25	80	1 00	09	09	08	11	75	21	27	2 50	06	17
Clinton,	63	1 05	1 00	06	05	06	09	80	25	23	1 00	06	16
Columbia,	80	75	83	05	07	07	08	75	22	23	....	05	17
Crawford,	1 00	70	65	10	10	08	08	58	15	20	77	03	13
Cumberland,	66	50	60	05	05	05	05	83	16	21	1 00	04	18
Dauphin,	72	68	93	05	05	06	11	80	10	25	1 31	06	18
Delaware,	....	....	....	....	....	....	....	90	....	....	....	08	22
Elk,	1 06	1 25	1 00	....	10	06	09	73	24	23	85	06	19
Erie,	77	73	70	08	07	08	07	65	21	22	78	05	20
Fayette,	90	63	1 00	08	10	08	09	1 00	25	22	....	07	21
Forest,	87	55	1 25	07	11	06	09	83	20	20	....	06	18

Franklin,	59	50	67	05	05	05	08	68	22	[illegible]	[illegible]	[illegible]	[illegible]
Fulton,	60	78	56	08	05	05	06	63	14	[illegible]	....	[illegible]	[illegible]
Greene,	47	63	1 00	09	09	06	08	80	17	[illegible]	....	[illegible]	[illegible]
Huntingdon,	1 00	90	1 30	....	05	06	07	85	25	[illegible]	....	[illegible]	[illegible]
Indiana,	45	50	90	10	05	08	08	50	15	[illegible]	....	[illegible]	[illegible]
Jefferson,	60	....	1 00	05	05	07	08	75	22	[illegible]	....	[illegible]	[illegible]
Juniata,	56	48	1 00	04	05	04	06	66	16	[illegible]	....	[illegible]	[illegible]
Lackawanna,	1 00	1 00	1 42	05	07	10	11	68	23	[illegible]	[illegible]	[illegible]	[illegible]
Lancaster,	72	80	75	06	05	05	09	66	18	[illegible]	[illegible]	[illegible]	[illegible]
Lawrence,	91	73	1 00	05	06	07	07	94	20	[illegible]	[illegible]	[illegible]	[illegible]
Lebanon,	75	65	50	....	04	05	06	80	25	....	[illegible]	[illegible]	[illegible]
Lehigh,	72	76	1 00	08	09	08	09	64	20	[illegible]	[illegible]	[illegible]	[illegible]
Luzerne,	85	96	1 33	05	08	08	10	85	22	[illegible]	[illegible]	[illegible]	[illegible]
Lycoming,	82	71	95	08	08	08	08	75	22	[illegible]	....	[illegible]	[illegible]
McKean,	78	....	1 12	06	07	06	08	72	20	[illegible]	....	[illegible]	[illegible]
Mercer,	75	51	1 12	06	07	06	07	55	16	[illegible]	[illegible]	[illegible]	[illegible]
Mifflin,	53	47	77	05	05	06	06	68	19	[illegible]	....	[illegible]	[illegible]
Monroe,	85	76	1 13	07	07	08	10	80	21	[illegible]	[illegible]	[illegible]	[illegible]
Montgomery,	83	94	92	05	08	09	11	75	25	[illegible]	[illegible]	[illegible]	[illegible]
Montour,	70	62	1 06	04	06	08	08	58	20	[illegible]	[illegible]	[illegible]	[illegible]
Northampton,	82	75	82	09	06	07	09	71	21	[illegible]	[illegible]	[illegible]	[illegible]
Northumberland,	63	68	95	06	06	05	07	68	22	[illegible]	....	[illegible]	[illegible]
Perry,	61	41	64	07	05	05	06	84	16	[illegible]	....	[illegible]	[illegible]
Philadelphia,	1 25	1 00	1 00	10	10	06	10	80	28	[illegible]	[illegible]	[illegible]	[illegible]
Pike,	66	66	1 00	06	08	05	06	72	21	[illegible]	....	[illegible]	[illegible]
Potter,	70	....	1 10	....	....	06	09	60	23	[illegible]	[illegible]	[illegible]	[illegible]
Schuylkill,	90	70	86	09	05	08	10	86	24	[illegible]	[illegible]	[illegible]	[illegible]
Snyder,	50	80	76	04	04	04	06	70	1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Somerset,	67	80	1 00	08	07	07	08	65	19	[illegible]	[illegible]	[illegible]	[illegible]
Sullivan,	....	....	....	....	....	....	....	59	20	[illegible]	[illegible]	[illegible]	[illegible]
Susquehanna,	....	1 25	1 00	20	10	05	08	60	22	[illegible]	[illegible]	[illegible]	[illegible]
Tioga,	75	1 25	1 25	10	10	08	10	88	19	[illegible]	[illegible]	[illegible]	[illegible]
Union,	47	45	54	05	04	06	08	52	17	[illegible]	[illegible]	[illegible]	[illegible]
Venango,	77	53	1 00	08	08	07	08	66	20	[illegible]	[illegible]	[illegible]	[illegible]
Warren,	76	74	83	05	06	08	08	70	17	[illegible]	[illegible]	[illegible]	[illegible]
Washington,	77	75	1 00	06	10	10	11	1 04	19	[illegible]	[illegible]	[illegible]	[illegible]
Wayne,	75	....	68	10	09	07	09	64	20	[illegible]	[illegible]	[illegible]	[illegible]
Westmoreland,	70	75	1 45	05	06	08	10	96	22	[illegible]	[illegible]	[illegible]	[illegible]
Wyoming,	68	66	87	10	09	09	10	75	18	[illegible]	[illegible]	[illegible]	[illegible]
York,	75	51	66	06	06	06	17	69	18	[illegible]	[illegible]	[illegible]	[illegible]
Total,	$0 75	$1 72	$0 93	$0 07	$0 07	$0 07	$0 08	$0 75	$0 20	[illegible]	[illegible]	[illegible]	[illegible]

CROP REPORT FOR 1901—Continued.

Counties.	Wool. Short, unwashed.	Wool. Short, washed.	Wool. Medium, unwashed.	Wool. Medium, washed.	Wool. Long, unwashed.	Wool. Long, washed.	Farm Land. Value per acre. Improved.	Farm Land. Value per acre. Average.	Farm Wages. By year, with board.	Farm Wages. For summer months only.	Farm Wages. By day, with board.	Farm Wages. By day, without board.	Farm Wages. Whole year, without board.	Farm Wages. Harvest, by day.	Farm Wages. Household help, female, with board, per week.
Adams,	$0 17	$0 19	$0 18	$0 19	$0 21	$0 24	$51 00	$32 00	$130 00	$15 00	$0 85	$1 11	$215 00	$1 25	$1 55
Allegheny,	15	23	15	20	18	21	70 00	55 00	197 00	22 00	1 00	1 50	3 00	1 83	3 00
Armstrong,	....	....	16	22	....	....	58 00	33 00	141 00	20 00	95	1 33	275 00	1 75	2 50
Beaver,	16	23	17	23	15	22	35 00	20 00	180 00	13 00	1 00	1 42	250 00	1 42	2 50
Bedford,	16	24	18	....	....	....	31 00	29 00	130 00	14 00	73	1 13	....	1 00	1 50
Berks,	....	....	....	....	....	....	58 00	38 00	161 00	15 00	76	1 00	....	1 12	2 00
Blair,	16	30	18	30	18	30	60 00	45 00	168 00	16 00	1 00	1 32	296 00	1 66	2 00
Bradford,	15	20	16	22	17	22	35 00	27 00	186 00	19 00	86	1 24	304 00	1 37	2 12
Bucks,	....	....	....	....	....	....	77 00	58 00	161 00	18 00	1 00	1 33	235 00	1 81	2 70
Butler,	....	....	16	20	....	....	38 00	21 00	195 00	19 00	92	1 16	237 00	1 33	2 16
Cambria,	14	20	15	22	17	26	56 00	38 00	157 00	25 00	1 00	1 40	312 00	1 40	2 50
Cameron,	....	....	....	....	....	....	25 00	12 00	....	....	1 25	1 50	....	2 00	2 00
Carbon,	....	....	....	....	....	....	50 00	32 00	176 00	20 00	1 00	1 25	300 00	1 16	2 00
Centre,	20	30	20	30	20	30	45 00	38 00	130 00	16 00	75	1 00	183 00	1 25	1 50
Chester,	....	....	....	....	....	....	66 00	43 00	176 00	19 00	1 00	1 25	300 00	1 50	2 25
Clarion,	18	22	18	23	....	....	22 00	16 00	176 00	17 00	1 06	1 32	216 00	1 25	2 40
Clearfield,	....	....	16	24	....	....	32 00	20 00	220 00	23 00	1 00	1 25	300 00	1 50	2 00
Clinton,	....	....	18	25	19	26	105 00	55 00	176 00	16 00	90	1 25	240 00	1 38	2 00
Columbia,	....	....	14	21	17	....	55 00	33 00	130 00	15 00	83	1 08	300 00	1 08	2 00
Crawford,	....	....	17	23	15	23	21 00	17 00	150 00	18 00	88	1 00	225 00	1 28	2 13
Cumberland,	18	22	18	28	....	....	100 00	55 00	150 00	13 00	75	1 05	225 00	1 25	1 75
Dauphin,	13	18	15	20	17	22	80 00	50 00	120 00	14 00	1 00	1 20	150 00	1 30	1 81
Delaware,	....	....	....	....	....	....	125 00	100 00	212 00	20 00	1 00	1 50	....	2 00	2 75
Elk,	19	24	18	23	18	23	15 00	19 00	240 00	25 00	1 13	1 60	260 00	1 87	2 75
Erie,	14	18	16	20	14	18	63 00	31 00	193 00	20 00	1 08	1 42	300 00	1 58	2 16
Fayette,	16	18	16	20	20	26	75 00	45 00	215 00	20 00	1 00	1 25	200 00	1 37	2 12

[illegible]	1[illegible]	20	16	[illegible]1	[illegible]	[illegible]	23 00	11 00	196 00	23 00	1 00	1 50	385 00	1 7[illegible]	[illegible]
Franklin,	[illegible]	[illegible]	17	[illegible]	1[illegible]	[illegible]	76 00	68 00	[illegible]	[illegible]	77	1 [illegible]	[illegible]	1 [illegible]	1 [illegible]
Fulton,	14	19	12	[illegible]	1[illegible]	21	41 00	14 00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1 17	1 [illegible]
Greene,	17	21	18	[illegible]1	1[illegible]	[illegible]	52 00	35 00	220 00	22 00	87	1 16	282 00	1 42	2 [illegible]
Huntingdon,	....	....	16	....	....	....	40 00	21 00	165 00	17 00	92	1 15	225 00	1 22	2 00
[illegible]					1[illegible]		45 00	32 00	159 00	17 00	1 00	1 25	250 00	1 25	2 00
Jefferson,	14	21	16	21	....	....	40 00	25 00	....	[illegible]	1 [illegible]	1 [illegible]	....	1 [illegible]	1 [illegible]
[illegible]	....	....	....	....	....	....	53 00	26 00	11[illegible] 00	12 00	[illegible]	[illegible]	[illegible]	1 [illegible]	1 50
Lackawanna,	21	23	20	22		[illegible]	57 00	36 00	193 00	18 00	1 00	1 25	122 00	1 50	2 00
Lancaster,	16	27	19	22		[illegible]	86 00	72 00	155 00	16 00	94	1 20	221 00	1 37	1 75
Lawrence,	14	19	15	21	[illegible]	[illegible]	52 00	37 00	162 00	18 00	1 00	1 50	271 00	1 55	2 40
Lebanon,	....	....	....	....		....	70 00	60 00	200 00	....	1 00	1 25	400 00	1 25	2 75
Lehigh,	18	22	17	18		[illegible]	86 00	56 00	115 00	15 00	88	1 17	250 00	1 20	2 10
Luzerne,	18	20	17	2[illegible]	[illegible]	1[illegible]	63 00	20 00	193 00	19 00	88	1 18	360 00	1 50	2 00
Lycoming,	15	22	....	....	....	....	56 00	27 00	167 00	16 00	87	1 25	250 00	1 30	2 00
McKean,					....	....	28 00	21 00	225 00	24 00	1 00	1 50	....	1 75	2 50
[illegible]			[illegible]		[illegible]	1[illegible]	44 00	33 00	167 00	18 00	1 00	1 28	245 00	1 31	2 13
Mifflin,	[illegible]	[illegible]			....	....	60 00	44 00	156 00	17 00	83	1 08	225 00	1 12	1 94
[illegible]					....	....	52 00	25 00	158 00	16 00	76	1 15	300 00	1 31	2 25
[illegible]					....	....	66 00	48 00	170 00	20 00	1 08	1 42	287 00	1 50	2 16
[illegible]					....	....	46 00	26 00	137 00	15 00	75	1 00	245 00	1 00	1 95
[illegible]					....	....	85 00	58 00	140 00	14 00	1 00	1 25	245 00	1 60	2 10
[illegible]	[illegible]		[illegible]		[illegible]	15	66 00	46 00	137 00	14 00	75	1 11	220 00	1 22	1 [illegible]0
Perry,	[illegible]	1	1			....	46 00	33 00	134 00	12 00	66	91	181 00	1 05	1 77
[illegible]			1			....	330 00	150 00	240 00	28 00	1 00	1 38	420 00	2 00	4 00
[illegible]						....	45 00	29 00	146 00	14 00	75	1 00	....	1 42	2 33
[illegible]	[illegible]		[illegible]			....	23 00	20 00	150 00	20 00	1 00	1 30	215 00	1 4[illegible]	2 33
[illegible]					....	....	50 00	42 00	180 00	19 00	88	1 08	210 00	1 25	2 66
Snyder,					....	....	71 00	52 00	116 00	15 00	81	1 07	225 00	1 12	1 88
[illegible]					[illegible]	26	10 00	30 00	170 00	19 00	96	1 20	280 00	1 16	1 75
[illegible]					....	....	30 00	20 00	180 00	18 00	1 00	1 25	....	1 50	2 00
[illegible]			[illegible]			27	25 00	18 00	180 00	20 00	1 00	1 2[illegible]	200 00	1 [illegible]0	2 00
[illegible]	[illegible]		1	....		....	60 00	23 00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2 62
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	....	....	80 00	54 00	121 00	13 00	72	96	218 00	1 08	1 50
Venango,	16	20	18	22	20	2[illegible]	42 00	[illegible]	186 00	21 00	87	1 25	283 00	1 [illegible]1	2 12
[illegible]			....	....	....	....	35 00	27 00	210 00	20 00	1 00	1 33	300 00	1 50	2 50
Washington,	18	20	20	22	20	[illegible]	88 00	56 00	185 00	18 00	1 08	1 58	250 00	1 50	2 50
Wayne,	17	21	....	....	....	....	28 00	25 00	180 00	20 00	1 00	1 38	276 00	1 43	2 [illegible]0
Westmoreland,	16	20	....	....	....	....	84 00	53 00	175 00	19 00	1 22	1 48	275 00	1 [illegible]2	3 [illegible]
[illegible]	[illegible]				....	....	35 00	26 00	171 00	17 00	1 00	1 25	256 00	1 58	2 16
[illegible]			1	..	16	22	42 00	29 00	140 00	16 00	85	1 20	2[illegible]0 00	1 25	2 [illegible]0
Total,	$0 16	$0 21	$0 17	$0 22	$0 18	$0 23	$58 00	$28 00	$168 00	$18 00	$0 92	$1 23	$260 00	$1 39	$2 19

Average Cost per Acre of Raising Wheat and Corn in the United States—1893.*

(U. S. Department of Agriculture.)

	Wheat.	Corn.
Rent of land,	[illegible] 81	$[illegible] 03
Manure or fertilizers,	[illegible] 16	1 86
Preparing ground,	1 87	1 62
Seed,	[illegible]	....
Sowing or planting,	37	[illegible]
Cultivating,	....	1 8[illegible]
Harvesting,	1 19	1 22
Threshing,	1 2[illegible]	....
Housing,	[illegible]	[illegible]
Marketing,	76	1 [illegible]
Total,	$.1 69	$ 1 71

*Data for wheat and corn consolidated from returns from nearly 30,000 leading farms scattered throughout the United States.

CALCULATION OF THE COMPOSITION OF MIXED FEEDS.

BY DR. WM. FREAR, *Chemist of the Penna. State Agr. Expt. Station.*

The recent act regulating the manufacture of mixed and concentrated cattle foods in Pennsylvania requires, that to each package, or lot of the foods, included under the provisions of the act, shall be attached a brand and a guaranty of the percentage of protein and fat the goods contain. Many inquiries have been received from manufacturers and dealers for information enabling them to comply with the guaranty requirement.

Where the quantities of the goods sold permit their manufacture in large quantities, so that considerable values are involved, the guaranty should be based upon an analysis of a carefully drawn, representative sample of each lot manufactured; or upon calculations from the quantities and composition of the ingredients* used; the latter being either purchased upon guaranty or themselves separately analyzed.

The State has made no provision for the analysis, at public cost, of manufacturers' samples.

A word of caution to those desiring to send samples of feed-stuffs to a chemist for analysis: It is just as important in the determination of the composition of a material as a basis for its sale under guaranty, that the sample shall be thoroughly representative, as that the analysis shall be made accurately. Perfect mixing of feed-stuffs is difficult, especially if fine, dense particles be mixed with coarse, light materials, such as oat hulls, bran, etc. A handful of the mixture taken at random from the top of a heap or bin is not at all likely to represent the average composition of the entire mass. To secure such a sample, portions must be drawn from different parts of the heap or bin, especially from the bottom and interior as well as from the top and exterior; the several portions so

*Note. In this circular the term "ingredient" refers to the individual feeding stuffs that are used in making a mixture, oats, middlings, corn chop or rye bran, for example; the term "constituent" refers, on the other hand, to the several groups of chemical substances of which plant materials, and each ingredient as such, are composed as protein, fat, fiber, ash, etc.

drawn should, according to quantity taken, be placed upon a clean, smooth floor, sheet or paper, thoroughly mixed and then quartered; if the quantity in one of the quarters of the heap of combined sub-samples is too much to submit for analysis, repeat with it the process to which the larger quantity of material has been subjected; and so on, until the quantity is reduced to a convenient amount for mail or express. Of fine-ground materials, four to eight ounces is usually sufficient; of coarser feeds, send double or treble this amount.

There are many cases, however, in which the quantity sold of any particular mixture is so small that the expense of analysis seems relatively high; and some other method of fixing upon a safe guaranty is sought. The composition of the mixture can readily be computed from the weights of the several ingredients and their respective percentage compositions, where these facts are known.

The ingredients commonly employed may be regarded as belonging to two quite distinct classes, the first, including whole grains or their milling products prepared under the ordinary conditions of milling by the mixer himself; the second, including proprietary mixtures or other materials bought from parties and concerning whose composition often little is certainly known.

Jenkins and Winton gathered together some years ago, the results of American analysis of the first class of ingredients, and presented them in tabular form so as not only to show their average composition in the more important constituents, but also the extreme variations in percentage of the several constituents that have been found in America. An abstract of that table is appended to this circular. (See Table No. I).

No such exact knowledge is possessed concerning the second class of ingredients, not only because they have been produced by others than the mixer and are therefore subject to adulterations of which he can have no knowledge, but also because the materials are often mixtures that vary in their composition because of a change in the manufacturing methods as a result of which they are produced; or that are varied by the makers from time to time as their profit may indicate. The local mixer is, in such case, compelled either to buy them under guaranty of composition from responsible parties or to have them analyzed. The results of analysis of a large number of such of these feeds as find their way to the retail market are presented in Bulletin No. 81 of the Department, which can be had upon application.

HOW TO USE THE TABLES OF ANALYSIS.

1. *To determine upon a percentage for guaranty:* All the raw or unmanufactured feeding-stuffs are seen, by reference to the tables, to vary considerably in composition; there is no certain indication

afforded by external appearance or simple physical test of the extent nor even in many cases of the direction in which a particular lot of any given material will depart in composition from the average feed if its kind. When all external qualities indicate that the feed is of good grade, the tendency, under conditions of strong competition, is to offer a guaranty high for goods of its class; but because appearances are often deceptive, the wise rule is *to guarantee the presence of no larger quantity of the several valuable ingredients that one may, with fair certainty, assume to be present.* This rule does not require that the guaranty shall be no higher than the lowest ever found for the kind of material in question, because these extreme figures usually attend some abnormality of growth or development; the rule would indicate, however, that for the purposes of guaranty, in the absence of the specific knowledge concerning the composition of the lot of goods employed which their analysis would afford, some figure between the average and the lowest should be chosen. To illustrate, the percentages of protein and fat given in the table for common, yellow dent corn are:

	Protein.	Fat.
Lowest,	7.5	3.1
Highest,	11.8	7.5
Average,	10.3	5.0

A great many samples of corn that appear to be of at least average quality, contain less than 10 per cent. of protein and 5 per cent. of fat. The percentage midway between the lowest and the average, that is, 9 per cent. for protein and 4 per cent. for fat, are the highest that can safely be adopted for guaranty in the absence of direct analysis of the goods in hand for use in any given mixture.

2. *To calculate the composition, for purposes of guaranty, of a mixture of feeding-stuffs, when the compositions and quantities of each ingredient of the mixture are known:*

Rule. In the case of each constituent required to be included in the guaranty, determine the number of pounds of it which each ingredient of the mixture supplies; this is done by multiplying the guaranty percentage of the constituent in each ingredient by the number of hundredweight of the latter used in the mixture. Next, ascertain the total amount of the constituent in the mixture by adding the amounts of it supplied by the several ingredients used. Finally, divide the sum thus obtained, by the number of hundredweights of the entire mixture; the result of this division is the guaranty percentage of this particular constituent for the entire mixture.

For example, let the problem be to determine the percentages of protein and fat to be stated in the guaranty for a mixture of 5,000 pounds of corn, 4,000 pounds of oats and 1,000 pounds of spring wheat bran. The guaranty percentage for the corn have been determined, those for the oats and bran remain to be fixed. The percentages of protein and fat given in the table for these feeds are:

	Oats.		Spring Wheat Bran.	
	Protein.	Fat.	Protein.	Fat.
Lowest,	8.9	3.4	14.3	3.6
Highest,	14.4	5.8	18.1	5.0
Average,	11.8	5.0	16.1	4.5

Pursuing the method adopted in the case of the corn, the following guaranty percentages are obtained:

	Protein.	Fat.
Oats,	10.3	4.2
Bran,	15.2	4.0

The calculation of the percentages of protein and fat in the mixture is made as follows:

Feed.		Protein.		Fat.	
Kind.	Cwt. used in mixture.	Per cent. in ingredients.	Pounds supplied by ingredients used	Per cent. in ingredients.	Pounds supplied by ingredients used.
Corn,	50.X	9.0	450	4.0	200
Oats,	40	10.3	412	4.2	168
Bran,	10	15.2	153	4.0	40
Total weight,	100		100)1,014		100)408
Percentages required,			10.14		4.08

3. *To calculate the quantities in which to combine certain ingredients of determined composition so as to make a mixture of a given composition:* In the first place, let the fixed point in the mixture be its percentage of but one of those constituents required to be named in the guaranty; protein may be taken, since it is the most expensive component, that for which concentrated feeds are chiefly sought and, at the same time, that which is most variable in percentage in the various ingredients used for mixing.

The simplest problem of this sort, is to determine the proportions in which to mix two known feeds to secure a mixture containing a given protein percentage. The percentage in the mixture must, of necessity, lie between those of the ingredients. Let the question be in what proportions to mix corn meal and pure buckwheat middlings, pure, so as to obtain a mixture having 14 per cent. of protein. The guaranty percentages of the two ingredients are: Corn meal, 8.1 per cent. protein, 2.9 per cent. fat; buckwheat middlings, 27 per cent. protein, 6.4 per cent. fat. Since the term *per cent.* means simply parts per bushel, it follows that 100 pounds of the two ingredients will contain, respectively, 8.1 and 27 pounds of protein, while every hundredweight of the mixture should have 14 pounds. That is, every hundredweight of corn meal will bring 5.9 pounds too little, while the same weight of buckwheat middlings will contribute an excess of 13 pounds. Obviously, only so much of the buckwheat middlings should be mixed with one hundredweight of the corn meal as will balance, by the protein it contributes in excess of the requirement, the deficiency of the corn meal. Since 100 pounds of middlings contains an excess of 13 pounds of protein, to supply an excess of 5.9 pounds of protein will require but 5.9-13 of 100, or 45.4 pounds of the middlings. The mixture should therefore contain 45.4 pounds of the middlings for every hundredweight of the meal used. From the fat percentages given above and these proportions of the ingredients, it can be calculated by the method stated for the second class of problems, that the guaranty percentage of fat in this mixture would be 3.92.

A very similar problem is that in which it is desired to ascertain in what proportions to use a highly nitrogenous material to balance up a mixture of less rich feeds whose quantities are already determined. Suppose, for example, that a mixer, having a corn and oats chop composed of 5,000 pounds of corn and 4,000 pounds of oats, desires to determine how much spring wheat bran must be added to produce a mixture having 11 per cent of protein. The calculation of problem two has shown that the 90 cwt. of mixed chop contains 862 pounds or 9.58 per cent. of protein and 368 pounds or 4.09 per cent. of fat. That is, the corn and oats alone form a mixture having 11 minus 9.58, or 1.42 pounds too little protein for every hundredweight

of the chop or 127.8 pounds too little in the entire 90 cwt. The excess protein in the bran, having a guaranty percentage of 15.2 per cent. is 4.2 pounds per cwt. To supply 127.8 pounds of such excess would therefore require 127. 8÷4.2, or 30.43 cwt. of the bran. The guaranty percentage of fat in the bran being 4 per cent. the bran would supply 121.7 pounds of fat; this added to the 368 pounds of the chop, would make 489.7 pounds in the mixture; since the latter has a weight of 9,000 plus 3,043 pounds, or 12,043 pounds, the percentage of the fat in the mixture must be 4.07 per cent.

4. The mixer has, however, more complex problems. It is often needful to determine not only how much but what kind of a balancing material to use in a brand of feeding-stuff whose main materials are already fixed, though it may be that the main ingredients may be varied in proportion according to the circumstances of supply and cost, which also affect the selection of the balancing material. Sometimes, too, it is desired to prepare a mixture which shall have not only a fixed percentage of portein, but of fat as well. In both sets or problems, the unknown quantities are too numerous to allow the formulation of any simple rule of calculation. The mixer must try, one after another, such a succession of proportions and ingredients as he may regard likely to meet his need, until he shall succeed in finding a combination nearly such as he desires. In each trial, however, he will find the methods already given, useful for his purpose.

TABLE NO. I.

COMPOSITION OF FEEDING STUFFS.

Giving the Maximum, Minimum and Average for Each Ingredient.

From Farm Bulletin No. 22 of the Department of Agriculture, Washington, D. C.

The figures given do not represent the results of single analyses, but are the highest and lowest results which have been found in the case of each ingredient. *They are given to show the limits within which each ingredient has been found to vary.*

Composition of Feeding Stuffs.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
GREEN FODDER.							
Corn fodder:*							
Flint varieties—	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	
Minimum,	[illegible]	[illegible]	[illegible]	2.1	[illegible]	[illegible]	....
Maximum,	[illegible]	1.8	[illegible]	[illegible]	[illegible]	1.3	....
Average,	[illegible]	1.1	[illegible]	[illegible]	12.1	0.7	[illegible]
Flint varieties cut after kernels had glazed—							
Minimum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	....
Maximum,	[illegible]	1.7	2.7	[illegible]	13.7	1.3	....
Average,	[illegible]	1.1	2.1	[illegible]	[illegible]	[illegible]	[illegible]
Dent varieties—							
Minimum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	....
Maximum,	[illegible]	2.5	[illegible]	[illegible]	[illegible]	[illegible]	....
Average,	[illegible]	1.2	1.7	[illegible]	[illegible]	[illegible]	[illegible]
Dent varieties cut after kernels had glazed—							
Minimum,	[illegible]	[illegible]	[illegible]	[illegible]	11.6	[illegible]	....
Maximum,	[illegible]	2.2	[illegible]	[illegible]	27.0	[illegible]	....
Average,	[illegible]	[illegible]	[illegible]	6.7	15.5	0.9	7

*Corn fodder is the entire plant, usually a thickly planted crop. Corn stover is what is left after the ears are harvested.

Composition of Feeding Stuffs.—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
GREEN FODDER—Continued.							
Sweet varieties—	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	
Minimum,	69.3	0.8	0.9	1.9	3.2	0.1	....
Maximum,	92.9	2.6	2.7	8.5	19.4	1.0	....
Average,	79.1	1.3	1.9	4.4	12.8	0.5	21
All varieties—							
Minimum,	51.5	0.6	0.5	1.9	3.0	0.1	....
Maximum,	93.6	2.6	4.0	11.4	36.3	1.6	....
Average,	79.3	1.2	1.8	5.0	12.2	0.5	126
Leaves and husks, cut green—							
Minimum,	57.9	2.1	1.8	6.6	16.7	1.0	....
Maximum,	71.3	4.4	2.4	12.5	22.2	1.3	....
Average,	66.2	2.9	2.1	8.7	19.0	1.1	4
Stripped stalks, cut green—							
Minimum,	74.5	0.6	0.4	6.7	14.2	0.4	....
Maximum,	77.4	0.8	0.6	8.8	16.0	0.6	....
Average,	76.1	0.7	0.5	7.3	14.9	0.5	4
Rye fodder:							
Minimum,	74.4	1.3	2.3	4.7	4.9	0.2	....
Maximum,	84.3	2.4	3.0	14.9	12.4	0.7	....
Average,	76.6	1.8	2.6	11.6	6.8	0.6	7
Oat fodder:							
Minimum,	31.3	1.5	1.5	7.1	10.8	0.4	....
Maximum,	78.6	4.2	6.1	16.8	39.8	3.0	....
Average,	62.2	2.5	3.4	11.2	19.3	1.4	6
Redtop,* in bloom:							
Minimum,	51.5	1.7	2.0	8.0	11.7	0.6	....
Maximum,	76.2	2.9	4.3	15.7	21.9	1.1	....
Average,	65.3	2.3	2.8	11.0	17.7	0.9	5
Tall oat grass, † in bloom:							
Minimum,	62.3	1.6	1.7	9.2	13.0	0.6	....
Maximum,	73.5	3.0	3.3	9.7	20.7	1.5	....
Average,	69.5	2.0	2.4	9.4	15.8	0.9	3
Orchard grass, in bloom:							
Minimum,	66.9	1.6	1.9	5.8	9.9	0.7	......
Maximum,	77.3	2.9	4.1	11.1	16.6	1.3	....
Average,	73.0	2.0	2.6	8.2	13.3	0.9	4
Meadow fescue, in bloom:							
Minimum,	67.6	1.6	1.8	10.2	12.5	0.7	....
Maximum,	73.2	2.0	2.7	11.3	15.7	1.1	....
Average,	69.9	1.8	2.4	10.8	14.3	0.8	4
Italian rye grass, coming into bloom:							
Minimum,	69.6	2.1	2.6	5.5	11.5	1.1	....
Maximum,	76.6	2.8	3.8	7.5	15.4	1.6	....
Average,	73.2	2.5	3.1	6.8	13.3	1.3	24
Timothy,‡ at different stages:							
Minimum,	47.0	1.4	1.3	5.1	10.1	0.6	....
Maximum,	78.7	3.2	3.8	19.4	28.6	2.0	....
Average,	61.6	2.1	3.1	11.8	20.2	1.2	56
Kentucky blue grass, § at different stages:							
Minimum,	51.7	1.6	2.4	3.8	6.5	0.8	....
Maximum,	32.5	4.8	7.2	13.4	25.6	1.9	....
Average,	65.1	2.8	4.1	9.1	17.6	1.3	18

*Herd's grass of Pennsylvania.
†Meadow oat grass.
‡Herd's grass of New England and New York.
§June grass.

Composition of Feeding Stuffs.—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
GREEN FODDER—Continued.							
Hungarian grass:	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	
Minimum,	62.7	1.9	2.8	7.6	9.1	0.5	....
Maximum,	[illegible]	2.2	[illegible]	[illegible]	[illegible]	[illegible]	
Average,	71.1	1.7	3.1	9.2	14.2	0.7	14
Red clover, at different stages:							
Minimum,	47.1	0.9	1.7	1.8	3.5	0.3	....
Maximum	91.8	4.0	7.1	14.7	25.8	1.8	....
Average,	70.8	2.1	4.4	8.1	13.5	1.1	43
Alsike clover,* in bloom:							
Minimum,	72.3	1.9	3.6	5.3	10.8	0.6	....
Maximum,	77.3	2.1	4.2	9.4	11.5	1.2	....
Average,	74.8	2.0	3.9	7.4	11.0	0.9	4
Crimson clover:							
Minimum,	78.4	1.4	2.7	3.5	7.0	0.6	....
Maximum,	84.6	2.0	3.5	6.3	9.7	0.8	....
Average,	80.9	1.7	3.1	5.2	8.4	0.7	3
Alfalfa,† at different stages:							
Minimum,	49.3	1.8	3.5	2.5	10.8	0.6	....
Maximum,	82.0	5.1	7.7	14.8	11.5	1.2	....
Average,	71.8	2.7	4.8	7.4	12.3	1.0	23
Serradella, at different stages:							
Minimum,	65.6	1.8	2.1	2.0	3.9	0.4	....
Maximum,	84.6	5.8	3.6	7.8	17.1	1.8	....
Average,	79.5	3.2	2.7	5.4	8.6	0.7	9
Cowpea:							
Minimum,	72.8	1.2	1.5	1.7	1.8	1.2	....
Maximum,	93.1	2.7	3.5	15.3	12.9	0.6	....
Average,	83.6	1.7	2.4	4.8	7.1	0.4	10
Soja bean:							
Minimum,	63.3	1.8	2.2	4.8	5.8	0.5	....
Maximum,	81.5	5.1	5.9	9.7	16.0	1.6	....
Average,	75.1	2.6	4.0	6.7	10.6	1.0	27
Horse bean:							
Average,	84.2	1.2	2.8	4.9	6.5	0.4	2
Flat pea (Lathyrus sylvestris):							
Average,	66.7	2.9	8.7	7.9	12.2	1.6	2
Rape:							
Average,	84.5	2.0	2.3	2.6	8.4	0.5	2
SILAGE.							
Corn silage:							
Minimum,	62.4	0.3	0.7	3.0	5.1	0.2	....
Maximum,	87.7	3.3	3.6	10.5	21.2	2.0	....
Average,	79.1	1.4	1.7	6.0	11.0	0.8	99
Sorghum silage:							
Minimum,	71.9	0.8	0.6	5.9	13.8	0.1	....
Maximum,	78.0	1.2	0.9	6.8	19.0	0.5	....
Average,	76.1	1.1	0.8	6.4	15.3	0.3	6
Red clover silage:							
Minimum,	61.4	1.9	3.0	5.1	8.1	0.9	....
Maximum,	78.6	3.0	5.9	13.9	14.3	1.6	....
Average,	72.0	2.6	4.2	8.4	11.6	1.2	....
Soja bean silage:							
Average,	74.2	2.8	4.1	9.7	8.9	2.2	1

*Swedish clover.

†Lucern

Composition of Feeding Stuffs.—Continued.

	Water.	Ash.	Protein	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
GREEN FODDER—Continued.							
Cowpea vine silage:	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	
Average,	79.3	2.9	2.7	6.0	7.6	1.5	2
Field pea vine silage:							
Average,	50.1	3.5	5.9	13.0	26.0	1.6	1
Silage of mixture of cowpea vines and soja bean vines, average,	69.8	4.5	3.8	9.5	11.1	1.3	1
HAY AND DRY COARSE FODDER.							
Corn fodder,* field cured:							
Minimum,	22.9	1.5	2.7	7.5	20.6	0.6	....
Maximum,	60.2	5.5	6.9	24.7	47.8	2.5	....
Average,	42.2	2.7	4.5	14.3	34.7	1.6	35
Corn leaves, field cured:							
Minimum,	14.8	4.3	4.5	17.4	27.3	0.8	....
Maximum,	44.0	7.4	8.3	27.4	41.4	2.2	....
Average,	30.0	5.5	6.0	21.4	35.7	1.4	17
Corn husks, field cured:							
Minimum,	26.7	0.6	1.3	6.8	14.3	0.5	....
Maximum,	76.6	2.3	3.2	23.6	43.6	1.0	....
Average,	50.9	1.8	2.5	15.8	28.3	0.7	16
Corn stalks, field cured:							
Minimum,	51.3	0.6	1.2	6.9	11.2	0.3	....
Maximum,	78.5	2.0	3.0	16.8	26.0	1.0	....
Average,	68.4	1.2	1.9	11.0	17.0	0.5	15
Corn stover, † field cured:							
Minimum,	15.4	1.7	1.9	14.1	23.3	0.7	....
Maximum,	57.4	7.0	8.3	32.2	53.3	2.2	....
Average,	40.5	3.4	3.8	19.7	31.5	1.1	60
Hay from:							
Redtop,‡ cut at different stages—							
Minimum,	6.8	3.8	5.9	24.0	44.8	1.4	....
Maximum,	11.6	7.0	10.4	31.8	50.4	3.2	....
Average,	8.9	5.2	7.9	28.6	47.5	1.9	9
Redtop, cut in bloom—							
Minimum,	6.8	4.8	7.8	24.0	46.8	1.5	....
Maximum,	11.6	6.5	10.4	31.8	47.8	2.3	....
Average,	8.7	4.9	8.0	29.9	46.4	2.1	3
Orchard grass—							
Minimum,	6.5	5.0	6.6	28.9	32.9	1.7	....
Maximum,	13.6	7.9	10.4	38.3	48.6	3.3	....
Average,	9.9	6.0	8.1	32.4	41.0	2.6	10
Timothy,§ all analyses—							
Minimum,	6.1	2.5	3.8	22.3	34.3	1.0	....
Maximum,	28.9	6.3	9.8	38.5	58.5	4.0	....
Average,	13.2	4.4	5.9	29.0	45.0	2.5	68
Timothy, cut in full bloom—							
Minimum,	7.0	2.5	5.0	22.2	34.4	2.0	....
Maximum,	28.9	6.0	7.5	37.1	48.5	4.0	....
Average,	15.0	4.5	6.[illegible]	29.6	41.9	3.0	11

*Entire plant.
†What is left after the ears are harvested.
‡Herd's grass of Pennsylvania.
§Herd's grass of New England and New York

Composition of Feeding Stuffs.—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
HAY AND DRY COARSE FODDER—Continued.							
Hay from:	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct	
Timothy, cut soon after bloom—							
Minimum,	7.8	3.5	4.6	25.7	37.0	1.7	....
Maximum,	21.6	5.4	8.1	33.4	51.0	3.6	....
Average,	14.2	4.4	5.7	28.1	44.6	3.0	11
Timothy, cut when nearly ripe—							
Minimum,	7.0	2.7	4.3	24.8	38.0	1.0	....
Maximum,	22.7	5.1	6.0	38.5	49.1	2.8	....
Average,	14.1	3.9	5.0	31.1	43.7	2.2	12
Minimum,	14.3	4.5	5.3	17.7	31.8	2.0	....
Maximum,	32.8	7.8	12.9	26.8	51.1	4.2	....
Average,	21.2	6.3	7.8	23.0	37.8	3.9	10
Cut, when seed was in milk—							
Minimum,	22.5	5.6	6.0	23.9	33.2	3.4	....
Maximum,	26.5	7.6	6.6	24.9	35.4	4.1	....
Average,	24.4	7.0	6.2	24.5	24.2	3.6	4
Cut, when seed was ripe—							
Minimum,	23.7	5.1	5.3	20.4	33.6	2.8	....
Maximum,	32.8	7.8	6.0	25.7	33.7	3.2	....
Average,	27.8	6.4	5.8	23.8	33.2	3.0	[illegible]
Hungarian grass—							
Minimum,	4.9	5.0	4.7	23.6	44.4	1.5	....
Maximum,	9.5	7.5	13.3	36.3	53.0	3.5	....
Average,	7.7	6.0	7.5	27.7	49.0	2.1	18
Meadow fescue—							
Minimum,	7.4	5.5	4.5	20.8	28.5	1.6	....
Maximum,	32.5	7.8	11.8	31.9	45.5	3.5	....
Average,	20.0	6.8	7.0	25.9	38.4	2.7	9
Italian rye grass—							
Minimum,	7.4	6.1	5.7	28.4	39.6	1.3	....
Maximum,	9.3	7.9	8.8	33.9	48.9	1.9	....
Average,	8.5	6.9	7.5	30.5	45.0	1.7	4
Mixed grasses—							
Minimum,	6.5	2.1	4.8	21.0	33.4	1.3	....
Maximum,	33.4	6.9	12.1	38.4	50.8	4.9	....
Average,	15.3	5.5	7.4	27.2	41.1	2.5	126
Hay from:							
Rowen (mixed)*—							
Minimum,	8.2	5.1	9.6	20.1	33.6	[illegible]	....
Maximum,	24.4	7.2	14.8	20.0	44.3	[illegible]	....
Average,	16.6	6.8	11.6	22.5	39.4	[illegible]	[illegible]
Mixed grasses and clovers—							
Minimum,	8.2	3.9	5.5	19.7	31.8	1.5	....
Maximum,	[illegible]	9.6	14.4	35.1	48.9	3.1	....
Average,	[illegible]	5.5	10.1	27.6	41.3	2.6	17
Swamp hay—							
Minimum,	7.8	3.3	5.0	19.4	30.9	0.8	....
Maximum,	17.9	12.1	8.8	31.6	51.7	3.6	....
Average,	11.6	6.7	7.2	26.6	45.9	2.0	[illegible]
Salt marsh—							
Minimum,	7.8	5.4	4.0	25.1	34.1	1.6	....
Maximum,	18.6	11.8	7.8	33.8	54.3	3.1	....
Average,	10.4	7.7	5.5	30.0	44.1	2.4	10

*Second cut.

Composition of Feeding Stuffs.—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
HAY AND DRY COARSE FODDER—Continued.							
Red clover—	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	
Minimum,	6.0	3.9	10.0	15.6	27.3	1.5	....
Maximum,	31.3	8.3	20.2	35.7	52.2	5.9	....
Average,	15.3	6.2	12.3	24.8	38.1	3.3	38
Red clover in bloom—							
Minimum,	6.0	5.6	10.8	17.9	27.3	2.5	....
Maximum,	31.3	8.3	15.4	28.1	41.3	5.9	....
Average,	20.8	6.6	12.4	21.9	33.8	4.5	6
Alsike clover—							
Minimum,	5.3	6.1	9.2	19.7	35.6	1.6	....
Maximum,	13.9	12.3	16.1	29.5	45.9	4.2	....
Average,	9.7	8.3	12.8	25.6	40.7	2.9	9
White clover—							
Minimum,	6.1	4.5	13.9	20.3	33.4	1.7	....
Maximum,	13.5	13.8	20.0	30.3	47.3	5.8	....
Average,	9.7	8.3	15.7	24.1	39.3	2.9	7
Crimson clover—							
Minimum,	5.9	7.4	13.6	20.1	29.3	1.5	....
Maximum,	13.4	13.0	16.1	34.9	42.6	4.8	....
Average,	9.6	8.6	15.2	27.2	36.6	2.8	7
Japan clover—							
Average,	11.0	8.5	13.8	24.0	39.0	3.7	2
Vetch—							
Minimum,	8.3	7.1	13.1	19.7	26.5	1.6	....
Maximum,	15.8	11.6	23.1	28.1	40.2	3.0	....
Average,	11.3	7.9	17.0	25.4	36.1	2.3	5
Serradella—							
Minimum,	7.2	5.4	13.9	19.4	40.5	2.2	....
Maximum,	11.7	10.3	16.6	22.9	46.0	2.9	....
Average,	9.2	7.2	15.2	21.6	44.2	2.6	2
Alfalfa*—							
Minimum,	4.6	3.1	10.2	14.0	35.1	1.1	....
Maximum,	16.0	10.4	23.3	33.0	53.6	3.8	....
Average,	8.4	7.4	14.3	25.0	42.7	2.2	21
Cowpea—							
Minimum,	7.6	3.2	13.6	16.4	39.4	1.1	....
Maximum,	14.0	10.2	20.3	25.0	49.5	3.7	....
Average,	10.7	7.5	16.6	20.1	42.2	2.2	8
Soja bean—							
Minimum,	6.1	4.8	14.0	17.3	31.8	2.4	....
Maximum,	20.1	8.9	18.1	32.3	41.0	7.5	....
Average,	11.3	7.2	15.4	22.3	38.6	5.2	6
Flat pea (Lathyrus sylvestris)—							
Minimum,	6.3	6.5	17.6	18.5	27.7	1.6	....
Maximum,	10.0	8.6	27.9	32.7	34.0	4.6	....
Average,	8.4	7.9	22.9	26.2	31.4	3.2	5
Peanut vines (without nuts)—							
Minimum,	6.3	7.3	9.1	18.3	33.1	1.7	....
Maximum,	7.8	15.7	11.7	33.3	50.4	5.8	....
Average,	7.6	10.8	10.7	23.6	42.7	4.6	6
Soja bean straw:							
Minimum,	5.7	3.9	4.0	34.0	35.3	0.8	....
Maximum,	14.0	4.9	4.9	49.6	43.3	3.2	....
Average,	10.1	5.8	4.6	40.4	37.4	1.7	4

*Lucern

Composition of Feeding Stuffs.—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
HAY AND DRY COARSE FODDER—Continued.							
Horsebean straw:	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	
Average,	9.2	[illegible]	[illegible]	37.6	34.3	[illegible]	1
Wheat straw:							
Minimum,	6.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Maximum,	17.9	[illegible]	[illegible]	42.7	[illegible]	[illegible]	
Average,	9.6	4.2	[illegible]	[illegible]	[illegible]	1.3	[illegible]
Rye straw:							
Minimum,	6.3	2.8	2.2	[illegible]	[illegible]	[illegible]	
Maximum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Average,	7.1	3.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oat straw:							
Minimum,	[illegible]	2.7	2.7	[illegible]	[illegible]	[illegible]	
Maximum,	11.4	6.7	[illegible]	[illegible]	[illegible]	[illegible]	
Average,	9.2	5.1	4.0	[illegible]	42.4	2.3	[illegible]
Buckwheat straw:							
Minimum,	[illegible]	[illegible]	[illegible]	37.2	[illegible]	[illegible]	
Maximum,	[illegible]	6.5	7.8	[illegible]	[illegible]	1.7	
Average,	9.9	5.5	5.2	[illegible]	[illegible]	[illegible]	[illegible]
ROOTS AND TUBERS.							
Potatoes:							
Minimum,	[illegible]	0.8	1.1	[illegible]	14.1	...	
Maximum,	82.2	1.2	[illegible]	[illegible]	[illegible]	[illegible]	
Average,	78.9	1.0	2.1	0.6	[illegible]	[illegible]	[illegible]
Sweet potatoes:							
Minimum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Maximum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Average,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Red beets:							
Minimum,	[illegible]	0.7	1.1	0.6	3.8	[illegible]	
Maximum,	[illegible]	[illegible]	1.8	[illegible]	[illegible]	[illegible]	
Average,	[illegible]	1.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sugar beets:							
Minimum,	[illegible]	[illegible]	1.1	[illegible]	[illegible]	[illegible]	
Maximum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Average,	[illegible]	[illegible]	1.8	[illegible]	[illegible]	[illegible]	[illegible]
Mangel-wurzels:							
Minimum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Maximum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Average,	[illegible]	1.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Turnips:							
Minimum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Maximum,	[illegible]	[illegible]	1.4	1.4	[illegible]	[illegible]	
Average,	[illegible]	[illegible]	1.1	1.2	[illegible]	[illegible]	[illegible]
Rutabagas:							
Minimum,	[illegible]	1.0	[illegible]	[illegible]	[illegible]	[illegible]	
Maximum,	[illegible]	1.4	[illegible]	[illegible]	[illegible]	[illegible]	
Average,	[illegible]	1.2	1.2	[illegible]	[illegible]	[illegible]	4
Carrots:							
Minimum,	[illegible]	[illegible]	0.8	[illegible]	[illegible]	[illegible]	
Maximum,	[illegible]	[illegible]	2.0	[illegible]	10.4	0.7	
Average,	[illegible]	[illegible]	1.1	[illegible]	[illegible]	[illegible]	[illegible]
Artichokes:							
Average,	79.5	1.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Composition of Feeding Stuffs.—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
GRAINS AND OTHER SEEDS.							
Corn kernels:	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	
Dent, all analyses—							
Minimum,	6.2	1.0	7.5	0.9	65.9	3.1	....
Maximum,	19.4	2.6	11.8	4.8	75.7	7.5	....
Average,	10.6	1.5	10.3	2.2	70.4	5.0	86
Flint, all analyses—							
Minimum,	4.5	1.0	7.0	0.7	65.0	3.4	....
Maximum,	19.6	1.9	13.7	2.9	76.7	7.1	....
Average,	11.3	1.4	10.5	1.7	70.1	5.0	68
Sweet, all analyses—							
Minimum,	6.0	1.4	9.5	1.5	61.8	3.8	....
Maximum,	10.9	2.4	15.3	5.2	72.4	9.3	....
Average,	8.8	1.9	11.6	2.8	66.8	8.1	[illegible]
Pop varieties—							
Minimum,	8.6	1.2	9.7	1.2	68.4	4.2	....
Maximum,	11.8	1.7	13.1	2.3	71.1	6.0	....
Average,	10.7	1.5	11.2	1.8	69.6	5.2	4
Soft varieties—							
Minimum,	6.1	1.4	8.8	1.3	66.0	5.0	....
Maximum,	14.1	1.9	14.6	3.3	75.5	5.7	....
Average,	9.3	1.6	11.4	2.0	70.2	5.5	5
All varieties and analyses—							
Minimum,	4.5	1.0	7.0	0.7	61.8	3.1	....
Maximum,	20.7	2.6	15.3	5.2	76.7	9.3	....
Average,	10.9	1.5	10.5	2.1	69.6	[illegible]	[illegible]
Sorghum seed:							
Minimum,	9.3	1.4	7.7	1.5	59.0	2.1	....
Maximum,	16.8	4.3	11.3	8.7	73.6	4.6	....
Average,	12.8	2.1	9.1	2.6	69.8	3.6	13
Barley:							
Minimum,	7.2	1.8	8.6	1.3	66.7	1.5	....
Maximum,	12.6	3.2	15.7	4.2	73.9	3.2	....
Average,	10.9	2.4	12.4	2.7	69.8	1.8	10
Oats:							
Minimum,	8.9	2.0	8.0	1.5	53.5	3.4	....
Maximum,	13.5	4.0	14.4	12.9	66.9	5.8	....
Average,	11.0	3.0	11.8	9.5	59.7	5.0	30
Rye:							
Minimum,	8.7	1.8	9.5	1.4	71.2	1.4	....
Maximum,	13.2	1.9	12.1	2.1	73.9	2.1	....
Average,	11.6	1.9	10.6	1.7	72.5	1.7	5
Wheat, spring varieties:							
Minimum,	8.1	1.5	8.4	1.3	66.1	1.8	....
Maximum,	13.4	2.6	15.4	2.3	74.9	2.6	....
Average,	10.4	1.9	12.5	1.8	71.2	2.2	18
Wheat, winter varieties, all analyses:							
Minimum,	7.1	0.8	8.1	0.4	66.7	1.3	....
Maximum,	14.0	3.6	16.6	2.9	77.7	3.9	... .
Average,	10.5	1.8	11.8	1.8	72.0	2.1	262
Wheat, all varieties:							
Minimum,	7.1	0.8	8.1	0.4	64.8	1.3	....
Maximum,	14.0	3.6	17.2	3.1	77.7	1.3	....
Average,	10.5	1.8	11.9	1.8	71.9	2.1	310
Rice:							
Minimum,	11.4	0.3	5.9	0.1	77.5	0.3	....
Maximum,	14.0	0.5	8.6	0.4	80.6	0.6	....
Average,	12.4	0.4	7.4	0.2	79.2	0.4	10

Composition of Feeding Stuffs.--Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
GRAINS AND OTHER SEED—Continued.							
Buckwheat:	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct	
Minimum,	10.9	[illegible]	8.6	7.8	[illegible]	[illegible]	......
Maximum,	[illegible]	[illegible]	11.0	9.4	[illegible]	[illegible]	......
Average,	[illegible]	[illegible]	10.0	8.7	[illegible]	[illegible]	[illegible]
Sunflower seed (whole):							
Minimum,	[illegible]	[illegible]	15.8	[illegible]	[illegible]	[illegible]	......
Maximum,	[illegible]	3.2	16.7	30.3	[illegible]	[illegible]	......
Average,	[illegible]	[illegible]	16.3	[illegible]	[illegible]	[illegible]	2
Cotton seed, whole (with hulls):							
Minimum,	[illegible]	[illegible]	14.5	[illegible]	[illegible]	[illegible]	......
Maximum,	[illegible]	4.5	21.7	[illegible]	[illegible]	[illegible]	......
Average,	[illegible]	[illegible]	18.4	[illegible]	[illegible]	[illegible]	[illegible]
Cotton seed kernels (without hulls):							
Minimum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......
Maximum,	[illegible]	[illegible]	[illegible]	4.4	[illegible]	[illegible]	......
Average,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
Cotton seed, whole, (roasted):							
Minimum,	[illegible]	2.3	[illegible]	[illegible]	21.1	[illegible]	......
Maximum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......
Average,	6.1	5.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Peanut kernels (without hulls):							
Minimum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......
Maximum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......
Average,	7.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7
Horse bean,	[illegible]	3.8	[illegible]	7.2	[illegible]	[illegible]	1
Soja bean:							
Minimum,	5.9	3.1	[illegible]	[illegible]	[illegible]	[illegible]	......
Maximum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......
Average,	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cowpea:							
Minimum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......
Maximum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......
Average,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.4	[illegible]
MILL PRODUCTS.							
Corn meal:							
Minimum,	8.0	[illegible]	7.1	[illegible]	[illegible]	[illegible]	......
Maximum,	[illegible]	4.1	[illegible]	[illegible]	[illegible]	[illegible]	......
Average,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Corn and cob meal:							
Minimum,	[illegible]	1.2	[illegible]	[illegible]	[illegible]	[illegible]	......
Maximum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.7	......
Average,	15.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7
Oat meal:							
Minimum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......
Maximum,	[illegible]	2.2	[illegible]	[illegible]	[illegible]	[illegible]	......
Average,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Barley meal:							
Minimum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......
Maximum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......
Average,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rye flour:							
Minimum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......
Maximum,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......
Average,	13.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4

Composition of Feeding Stuffs.—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
MILL PRODUCTS—Continued.							
Wheat flour, all analyses:	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	
Minimum,	8.2	0.3	8.6	0.1	71.5	0.6	....
Maximum,	13.6	0.7	13.6	1.0	78.5	1.8	....
Average,	12.4	0.5	10.8	0.2	75.0	1.1	20
Buckwheat flour:							
Minimum,	12.8	0.7	4.2	0.2	71.1	0.7	....
Maximum,	17.6	1.3	8.1	0.5	79.4	1.8	....
Average,	14.6	1.0	6.9	0.3	75.8	1.4	4
Ground linseed:							
Minimum,	7.9	3.4	20.3	5.0	25.5	30.3	....
Maximum,	8.3	6.1	23.0	6.9	30.2	30.5	....
Average,	8.1	4.7	21.6	7.3	27.9	30.4	2
Pea meal:							
Minimum,	8.9	2.6	19.1	17.1	50.2	0.9	....
Maximum,	12.1	2.7	21.4	17.7	52.0	1.5	....
Average,	10.5	2.6	20.2	14.4	15.1	1.2	2
Sojabean meal,	10.8	45.5	36.7	4.5	27.3	16.2	1
Ground corn and oats, equal parts:							
Minimum,	10.7	[illegible]	[illegible]	....	*70.4	4.6	....
Maximum,	13.1	2.7	10.4	....	*73.4	5.0	....
Average,	11.9	2.2	9.6	....	*72.0	4.4	6
WASTE PRODUCTS.							
Corn-cob:							
Minimum,	7.2	0.7	1.2	18.2	43.8	0.1	....
Maximum,	24.8	2.7	3.7	38.3	66.7	0.9	....
Average,	10.7	1.4	2.4	30.1	54.9	0.5	18
Hominy chops:							
Minimum,	8.1	1.9	7.9	2.5	61.0	4.5	....
Maximum,	13.5	3.1	11.2	6.7	71.1	11.2	....
Average,	11.1	2.5	9.8	3.8	64.5	8.3	12
Corn-germ:							
Minimum,	9.4	1.9	9.7	1.9	61.9	5.2	....
Maximum,	13.0	7.4	9.9	5.8	67.4	11.2	....
Average,	10.7	4.0	9.8	4.1	64.0	7.4	3
Corn-germ meal:							
Minimum,	6.5	0.8	10.0	7.8	57.4	4.3	....
Maximum,	9.9	2.6	14.0	13.0	67.0	11.2	....
Average,	8.1	1.3	11.1	9.9	62.5	7.1	6
Gluten meal:							
Minimum,	6.2	0.5	21.3	0.3	34.0	3.4	....
Maximum,	12.3	2.0	39.2	7.8	58.5	20.0	....
Average,	8.8	0.8	29.7	2.2	49.8	8.7	54
Recent analyses—							
Minimum,	6.2	0.5	21.4	0.6	34.0	6.6	....
Maximum,	11.1	2.0	39.3	7.8	58.4	20.0	....
Average,	8.2	0.9	29.3	3.3	46.5	11.8	20
Chicago†—							
Average,	10.1	1.1	30.1	1.6	48.7	8.4	8
Buffalo†—							
Average,	8.2	0.8	23.3	6.1	50.4	11.2	5
Cream gluten:							
Minimum,	7.7	0.6	34.1	1.2	35.0	13.6	....
Maximum,	9.0	0.8	38.2	1.3	41.1	15.8	....
Average,	8.1	0.7	36.1	1.3	39.0	14.8	[illegible]

*Including fiber.
†Included in above average.

Composition of Feeding Stuffs.—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
WASTE PRODUCTS—Continued.							
Gluten feed:	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	
Minimum,	6.3	0.7	19.5	1.5	44.5	7.0	....
Maximum,	9.0	1.8	28.3	8.2	58.0	12.6	....
Average,	7.8	1.1	24.0	5.3	41.2	10.6	31
Buffalo†—							
Average,	7.7	1.1	25.0	5.3	49.3	11.6	5
Pope's,	14.0	0.6	32.3	1.6	36.5	14.1	1
Peoria,†	7.5	0.8	19.8	8.2	51.1	12.6	1
Chicago maize feed:							
Minimum,	8.6	0.7	19.3	6.8	49.2	5.6	....
Maximum,	9.7	1.1	26.9	8.7	56.1	7.9	....
Average,	9.1	0.9	22.8	7.6	52.7	[illegible]	[illegible]
Glucose feed and glucose refuse:							
Average,	6.5	1.1	20.7	4.5	56.8	[illegible]	[illegible]
Dried starch feed and sugar feed:							
Minimum,	9.2	0.6	17.1	3.1	45.2	7.3	....
Maximum,	11.7	1.2	22.1	5.6	59.6	11.1	....
Average,	10.9	0.9	19.7	4.7	54.8	9.0	4
Starch feed, wet:							
Minimum,	62.3	0.1	3.6	1.6	18.7	1.3	....
Maximum,	72.2	0.6	9.6	4.4	28.9	4.4	....
Average,	65.4	0.3	6.1	3.1	22.0	3.1	12
Oat feed:							
Minimum,	6.4	3.2	12.6	3.7	56.2	6.1	....
Maximum,	9.2	4.2	20.0	12.5	63.7	7.8	....
Average,	7.7	3.7	16.0	6.1	59.4	7.1	4
Barley screenings:							
Minimum,	12.0	3.5	12.1	7.0	61.6	2.6	....
Maximum,	12.4	3.6	12.5	7.6	62.0	2.9	....
Average,	12.2	3.6	12.3	7.3	61.8	2.8	2
Malt sprouts:							
Minimum,	7.3	3.8	21.0	9.3	45.5	1.0	....
Maximum,	12.0	6.7	25.9	12.0	50.3	3.0	....
Average,	10.2	5.7	23.2	10.7	48.5	1.7	4
Brewers' grains, wet:							
Minimum,	68.6	0.3	4.3	3.1	9.6	0.8	....
Maximum,	79.4	1.5	6.9	5.6	15.9	2.8	....
Average,	75.7	1.0	5.4	3.8	12.5	1.6	15
Brewers' grains, dried:							
Minimum,	6.2	3.3	19.3	10.2	46.1	4.2	....
Maximum,	11.9	3.8	29.3	11.6	[illegible]	6.5	....
Average,	8.2	3.6	19.9	11.0	51.7	5.6	3
Grano gluten,	5.8	2.8	31.1	12.0	33.4	14.9	1
Rye bran:							
Minimum,	8.2	2.9	11.5	2.7	59.8	1.7	....
Maximum,	13.7	4.5	16.8	4.1	67.6	4.9	....
Average,	11.6	3.6	14.7	3.5	63.8	2.8	7
Wheat bran from spring wheat:							
Minimum,	7.4	4.0	14.3	5.4	51.7	2.6	....
Maximum,	13.6	6.0	18.1	10.1	58.1	5.0	....
Average,	11.5	5.4	16.1	8.0	54.5	4.5	10
Wheat bran from winter wheat:							
Minimum,	10.6	5.0	13.9	7.2	50.5	3.5	....
Maximum,	13.6	6.4	17.8	8.9	56.2	4.5	....
Average,	12.3	5.9	16.0	8.1	53.7	4.0	7

†Included in above average.

Composition of Feeding Stuffs.—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
WASTE PRODUCTS—Continued.							
Wheat bran, all analyses:	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	
Minimum,	7.4	2.5	12.1	2.4	45.5	1.5	....
Maximum,	15.8	7.8	18.9	15.5	63.2	7.0	....
Average,	11.9	5.8	15.4	9.0	53.9	4.0	88
Wheat middlings:							
Minimum,	9.2	1.4	10.1	1.3	53.0	2.1	....
Maximum,	16.0	6.3	20.0	12.7	70.9	5.9	....
Average,	12.1	3.3	15.6	4.6	60.4	4.0	32
Wheat shorts:							
Minimum,	4.1	2.0	11.1	6.0	50.0	2.5	....
Maximum,	15.5	6.2	19.4	10.5	67.0	6.1	....
Average,	11.8	4.6	14.9	7.4	56.8	4.5	12
Wheat screenings:							
Minimum,	7.8	1.9	8.3	1.7	61.0	2.7	....
Maximum,	13.6	3.8	16.9	7.5	70.4	3.3	....
Average,	11.6	2.9	12.5	4.9	65.1	3.0	10
Rice bran:							
Minimum,	8.8	8.4	10.9	2.0	41.9	5.2	....
Maximum,	10.7	12.4	13.6	17.8	62.3	10.9	....
Average,	9.7	10.0	12.1	9.5	49.9	8.8	5
Rice hulls:							
Minimum,	7.7	10.5	2.9	30.3	36.0	0.6	....
Maximum,	8.5	15.1	4.7	38.6	41.6	0.9	....
Average,	8.2	13.2	3.6	35.7	38.6	0.7	3
Rice polish:							
Minimum,	9.0	2.8	10.9	2.4	45.5	6.5	....
Maximum,	11.2	11.3	12.9	14.5	63.3	8.0	....
Average,	10.0	6.7	11.7	6.3	58.0	7.3	4
Buckwheat middlings:*							
Minimum,	9.5	4.4	25.1	2.4	36.3	5.7	....
Maximum,	16.3	5.5	31.3	5.7	52.7	8.1	....
Average,	13.2	4.8	28.9	4.1	41.9	7.1	....
Cotton seed meal:							
Minimum,	5.8	5.7	23.3	1.3	15.7	8.8	....
Maximum,	18.5	8.8	50.8	10.1	38.7	18.0	....
Average,	8.2	7.2	42.3	5.6	23.6	13.1	35
Cotton seed hulls:							
Minimum,	9.2	1.8	2.2	37.9	12.4	0.6	....
Maximum,	16.7	4.4	5.4	67.0	41.8	5.4	....
Average,	11.1	2.8	4.2	46.3	33.4	2.2	20
Linseed meal, old process:							
Minimum,	5.6	4.6	27.7	4.7	28.4	5.2	....
Maximum,	12.4	8.2	38.2	12.9	41.9	11.6	....
Average,	9.2	5.7	32.9	8.9	35.4	7.9	21
Linseed meal, new process:							
Minimum,	6.0	5.0	27.1	7.6	35.2	1.3	....
Maximum,	13.4	6.9	38.4	4.0	48.0	4.4	....
Average,	10.1	5.8	[illegible]	9.5	38.4	3.0	14
Peanut meal:*							
Minimum,	6.6	3.7	37.5	2.5	28.5	5.8	....
Maximum,	15.4	5.5	52.4	7.4	30.8	17.5	....
Average,	10.7	4.9	47.6	5.1	23.7	8.0	2,480
Peanut hulls:							
Minimum,	7.8	1.9	4.6	56.5	9.7	0.9	....
Maximum,	10.8	4.6	8.6	72.3	18.9	2.0	....
Average,	9.0	3.4	6.6	64.3	15.1	1.6	5

*Mostly European analyses.

Composition of Feeding Stuffs.—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
MILK AND ITS BY-PRODUCTS.							
Whole milk:	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	
Minimum,	80.3	0.4	2.1	....	2.1	1.7	....
Maximum,	90.7	1.2	6.4	....	6.1	6.5	....
Average,	87.2	0.7	3.6	....	4.9	3.7	798
Skim milk, cream raised by setting:							
Minimum,	88.3	0.5	2.6	....	3.8	0.2	....
Maximum,	92.6	1.0	3.9	....	5.5	2.5	....
Average,	90.4	0.7	3.3	....	4.7	0.9	96
Skim milk, cream raised by separator:							
Minimum,	89.8	....	....	....	....	....	....
Maximum,	91.2	....	....	....	....	....	....
Average,	90.6	0.7	3.1	....	5.3	0.3	7
Butter milk:							
Minimum,	82.2	0.4	1.7	....	2.5	....	....
Maximum,	93.3	0.9	6.2	....	5.6	5.4	....
Average,	90.1	0.7	4.0	....	4.0	1.1	85
Whey:							
Minimum,	93.2	0.3	0.3	....	4.4	0.0	....
Maximum,	91.6	0.6	1.2	....	5.8	0.2	....
Average,	93.8	0.4	0.6	....	5.1	0.1	46

TABLE NO. II.

POUNDS OF TOTAL DRY MATTER, TOTAL ORGANIC MATTER AND DIGESTIBLE INGREDIENTS (PROTEIN AND CARBOHYDRATES [INCLUDING ETHER EXTRACT MULTIPLIED BY 2.25]) IN VARYING WEIGHTS OF FODDERS AND FEEDS, BEING ESSENTIALLY A CONVENIENCE TABLE.

Pounds of Fodder.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.
Grasses	Pasture grass, 1:4.8.				Timothy grass, 1:14.3.				Red top grass, 1:14.6.			
2½	0.5	0.5	0.06	0.3	1.0	0.9	0.04	0.5	0.9	0.8	[illegible]	0.5
5	1.0	0.9	0.12	0.6	1.9	1.8	[illegible]	1.1	1.7	1.6	[illegible]	1.0
10	2.0	1.8	0.23	1.1	3.8	3.6	0.15	2.1	3.5	3.2	0.13	1.9
15	3.0	2.7	0.35	1.7	5.8	5.4	0.23	3.2	5.2	4.9	[illegible]	2.9
20	4.0	3.6	0.46	2.2	7.7	7.2	0.30	4.3	[illegible]	[illegible]	[illegible]	3.8
25	5.0	4.5	0.58	2.8	9.6	9.1	0.38	5.4	8.7	8.1	[illegible]	4.8
30	6.0	5.4	0.69	3.3	11.5	10.9	0.45	6.4	[illegible]	[illegible]	[illegible]	5.7
35	7.0	6.3	0.81	3.9	13.4	12.7	0.53	7.5	12.1	11.4	[illegible]	6.7
40	8.0	7.2	0.92	4.4	15.4	14.5	0.60	8.6	[illegible]	[illegible]	0.72	7.6
Grasses.	Kentucky blue grass, 1:5.2.				Green rowen, 1:5.1.				Green fodder corn, 1:11.7.			
2½	0.9	0.8	0.05	0.5	0.7	0.7	[illegible]	0.4	0.5	0.5	[illegible]	0.3
5	1.8	1.6	0.10	0.9	1.5	1.4	0.16	0.8	1.0	1.0	[illegible]	0.6
10	3.5	3.2	0.20	1.8	3.0	2.8	0.32	1.6	2.1	2.0	0.11	1.3
15	5.2	4.8	0.30	2.7	4.5	4.1	0.48	2.5	3.1	2.9	0.17	1.9
20	7.0	6.4	0.40	3.7	6.0	5.5	0.64	3.3	4.1	3.9	0.22	2.6
25	8.7	8.0	0.50	4.7	7.5	6.9	0.80	4.1	5.2	4.9	0.28	3.2
30	10.5	9.6	0.60	5.5	9.0	8.3	0.96	4.9	6.2	[illegible]	[illegible]	3.9
35	12.2	11.2	0.70	6.4	10.5	9.6	1.12	5.7	7.2	6.8	[illegible]	4.5
40	[illegible]	12.8	0.80	7.3	12.0	11.0	1.28	6.6	8.2	7.8	0.44	5.2
Green fodders.	Sweet corn fodder, 1:11.3.				Green barley fodder, 1:[illegible].7.				Green oat fodder, 1:[illegible].7.			
2½	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	1.0	1.0	0.06	0.7	1.2	1.1	[illegible]	0.7	[illegible]	1.8	0.12	1.0
10	2.1	2.0	0.12	1.4	[illegible]	[illegible]	[illegible]	1.4	[illegible]	3.5	0.24	2.1
15	[illegible]	[illegible]	[illegible]	2.1	[illegible]	[illegible]	[illegible]	2.1	[illegible]	[illegible]	[illegible]	3.1
20	4.2	3.9	0.24	2.7	[illegible]	4.6	[illegible]	2.7	7.6	7.1	0.48	4.2
25	[illegible]	[illegible]	[illegible]	3.4	6.2	[illegible]	[illegible]	[illegible]	[illegible]	8.9	[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10.6	0.72	6.2
35	[illegible]	[illegible]	[illegible]	4.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12.3	[illegible]	[illegible]
40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9.1	[illegible]	[illegible]	[illegible]	[illegible]	0.96	8.3

TABLE II.—POUNDS OF TOTAL DRY MATTER, TOTAL ORGANIC MATTER AND DIGESTIBLE INGREDIENTS—*Continued.*

Pounds of Fodder.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.
Green fodders.	Green rye fodder, 1:7.2.				Green hungarian, 1:8.7.				Oats and peas, 1:4.2			
2½,	0.6	0.5	0.05	0.4	0.7	0.7	0.05	0.4	0.5	0.5	0.07	0.3
5,	1.2	1.1	0.11	0.7	1.4	1.4	0.10	0.8	1.1	1.0	0.14	0.5
10,	2.3	2.2	0.21	1.5	2.9	2.7	0.20	1.7	2.1	2.0	0.27	1.1
15,	3.5	3.2	0.32	2.3	4.3	4.0	0.30	2.6	3.2	2.9	0.41	1.7
20,	4.7	4.3	0.42	3.0	5.8	5.4	0.40	3.5	4.3	3.9	0.54	2.[illegible]
25,	5.9	5.4	0.52	3.8	7.2	6.8	0.50	4.3	5.3	4.9	0.68	2.9
30,	7.0	6.5	0.63	4.5	8.7	8.2	0.60	5.2	6.4	5.9	0.81	3.[illegible]
35,	8.2	7.6	0.74	5.3	10.1	9.5	0.70	6.1	7.5	6.8	0.95	4.[illegible]
40,	9.4	8.6	0.84	6.0	11.6	10.9	0.80	6.9	8.5	7.8	1.08	4.[illegible]
Green fodders.	Barley and peas, 1:3.2.				Red clover (green), 1:5.7.				Alsike clover (green) 1:5.3.			
2½,	0.5	0.5	0.07	0.2	0.7	0.7	0.07	0.4	0.6	0.6	0.07	0.3
5,	1.0	0.9	0.14	0.4	1.5	1.4	0.15	0.8	1.3	1.2	0.13	0.7
10,	2.1	1.9	0.28	0.9	2.9	2.7	0.29	1.6	2.5	2.3	0.26	1.4
15,	3.1	2.8	0.42	1.4	4.4	4.0	0.44	2.5	3.8	3.5	0.39	2.1
20,	4.1	3.8	0.56	1.8	5.9	5.4	0.58	3.3	5.0	4.7	0.52	2.8
25,	5.2	4.7	0.70	2.3	7.3	6.8	0.73	4.1	6.3	5.9	0.65	3.5
30,	6.2	5.6	0.84	2.7	8.8	8.2	0.87	4.9	7.6	7.0	0.78	4.2
35,	7.2	6.6	0.98	3.2	10.2	9.5	1.02	5.7	8.8	8.1	0.91	4.9
40,	8.2	7.5	1.12	3.6	11.7	10.9	1.16	6.6	10.1	9.3	1.04	5.6
Green fodders and silages.	Green clover rowen 1:4.2.				Corn silage (mature), 1:14.8.				Corn silage (immature), 1:14.8.			
2½,	0.6	0.6	0.07	0.3	0.7	0.6	0.03	0.4	0.5	0.5	0.02	0.3
5,	[illegible]	1.2	0.14	0.6	1.3	1.2	0.06	0.8	1.0	1.0	0.05	0.6
10,	[illegible]	2.3	0.29	1.2	2.6	2.5	0.12	1.8	2.1	2.0	0.09	1.3
15,	[illegible]	3.5	0.44	1.6	3.9	3.6	0.18	2.7	3.1	2.9	0.14	1.9
20,	[illegible]	4.6	0.58	2.4	5.3	4.9	0.24	3.6	4.2	3.9	0.18	2.6
25,	[illegible]	5.8	0.73	3.0	6.6	6.2	0.30	4.5	5.2	4.9	0.23	3.2
30,	[illegible]	6.9	0.87	3.6	7.9	7.4	0.36	5.3	6.2	5.9	0.27	3.9
35,	[illegible]	8.1	1.02	4.2	9.2	8.7	0.42	6.2	7.3	6.8	0.32	4.5
40,	[illegible]	[illegible]	1.16	4.8	10.5	[illegible]	0.48	7.1	8.4	7.8	0.36	5.2

TABLE II.—POUNDS OF TOTAL DRY MATTER, TOTAL ORGANIC MATTER AND DIGESTIBLE INGREDIENTS—*Continued.*

Pounds of Fodder.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.
Silages, etc.	Corn stover silage 1:16.6.				Clover silage, 1:4.7.				Potatoes, 1:1[illegible].3.			
2½,	0.5	0.4	0.02	0.3	0.7	0.6	0.07	0.3	0.5	0.5	0.02	0.4
5,	1.0	0.9	0.03	0.5	1.4	1.2	0.14	0.6	1.1	1.0	0.05	[illegible]
10,	1.9	1.8	0.06	1.0	2.8	[illegible]	0.27	1.3	2.1	2.0	0.09	1.6
15,	2.9	2.6	0.09	1.5	4.2	[illegible]	0.41	1.9	3.2	3.0	0.14	[illegible]
20,	3.9	3.5	0.12	2.0	5.6	5.1	0.54	2.6	4.2	4.0	0.18	3.1
25,	4.8	4.4	0.15	2.5	7.0	[illegible]	0.68	3.2	5.3	5.0	0.23	[illegible]
30,	5.8	5.3	0.18	3.0	8.4	[illegible]	0.81	3.9	6.3	6.0	0.27	4.7
35,	6.8	6.1	0.21	3.5	9.8	[illegible]	0.95	4.5	7.4	7.0	0.32	[illegible]
40,	7.7	7.0	0.24	4.0	11.2	10.2	1.08	5.1	8.4	8.0	0.36	6.2
Roots.	Beets, 1:6.5.				Sugar beets, 1:6:8.				Carrots, 1:9.6.			
2½,	0.3	0.3	[illegible]	0.2	0.3	[illegible]	0.04	0.3	0.3	0.3	0.03	[illegible]
5,	0.6	0.5	[illegible]	0.5	0.7	[illegible]	0.08	0.5	0.5	0.5	0.05	[illegible]
10,	1.2	1.1	0.14	0.9	1.4	[illegible]	0.16	1.1	1.1	1.0	0.10	0.1
15,	1.7	1.6	0.21	1.4	2.0	[illegible]	0.24	1.7	1.6	1.6	0.15	1.4
20,	2.3	2.1	0.28	1.8	2.7	[illegible]	0.32	2.2	2.3	2.1	0.20	[illegible]
25,	2.9	2.6	[illegible]	2.3	3.4	[illegible]	0.40	2.7	2.9	2.6	0.25	[illegible]
30,	3.5	3.1	0.42	2.7	4.1	3.8	0.48	3.3	3.4	3.1	0.30	[illegible]
35,	4.0	3.7	[illegible]	3.2	4.7	4.4	0.56	3.8	4.0	3.6	0.35	3.4
40,	4.6	4.2	[illegible]	3.6	5.4	5.0	0.64	4.4	4.6	4.2	0.40	3.8
Roots.	Mangel wurtzels, 1:4.9.				Rutabagas, 1:8.6.				Turnips, 1:7.7.			
2½,	0.2	0.2	0.03	0.1	0.3	0.2	0.03	0.2	0.2	0.2	0.03	0.2
5,	0.4	0.4	[illegible]	0.3	0.5	[illegible]	0.05	0.4	0.5	0.4	0.05	0.4
10,	0.9	0.8	0.11	0.5	1.1	[illegible]	0.10	0.9	[illegible]	0.9	0.10	0.8
15,	1.4	1.2	0.17	0.8	1.6	[illegible]	0.15	1.3	1.4	1.3	0.15	1.2
20,	1.8	1.6	0.22	1.1	2.3	[illegible]	0.20	1.7	[illegible]	1.7	0.20	1.5
25,	2.3	2.0	[illegible]	1.4	2.9	2.6	0.25	2.2	[illegible]	2.2	0.25	1.9
30,	2.7	2.4	[illegible]	1.6	3.4	3.1	0.30	2.6	[illegible]	2.6	0.30	[illegible]
35,	3.2	2.8	[illegible]	1.9	4.0	3.6	0.35	3.0	3.3	3.0	0.35	2.7
40,	3.6	3.2	0.44	2.2	4.6	4.1	0.40	3.4	3.8	3.5	0.40	3.1

TABLE II.—POUNDS OF TOTAL DRY MATTER, TOTAL ORGANIC MATTER AND DIGESTIBLE INGREDIENTS—*Continued.*

Pounds of Fodder.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.
Milk.	Skim milk, 1:2.0.				Butter milk, 1:1.7.				Whey, 1:8.7.			
2½,	0.2	0.2	0.07	0.1	0.2	0.2	0.10	0.2	0.2	0.1	0.02	0.1
5,	0.5	0.4	0.15	0.3	0.5	0.5	0.19	0.3	0.3	0.3	0.03	0.3
10,	0.9	0.9	0.29	0.6	1.0	0.9	0.38	0.6	0.6	0.6	0.06	0.5
15,	1.4	1.3	0.44	0.9	1.5	1.4	0.57	1.0	0.9	0.8	0.09	0.8
20,	1.9	1.7	0.58	1.2	2.0	1.8	0.76	1.3	1.2	1.2	0.12	1.0
25,	2.4	2.2	0.73	1.6	2.5	2.3	0.95	1.6	1.5	1.5	0.15	1.3
30,	2.8	2.6	0.87	1.8	3.0	2.8	1.14	1.9	1.9	1.8	0.18	1.6
35,	3.2	3.0	1.02	2.1	3.5	3.3	1.33	3.2	2.2	2.0	0.21	1.8
40,	3.7	3.5	1.16	2.4	4.0	3.7	1.52	2.6	2.5	2.3	0.24	2.1
Hays.	Mixed hay, 1:10.0.				Timothy hay, 1:16.5.				Red top hay, 1:10.3.			
2½,	2.1	2.0	0.11	1.1	2.2	2.1	0.07	1.2	2.3	2.1	0.12	1.2
5,	4.2	4.0	0.22	2.2	4.3	4.1	0.14	2.3	4.6	4.3	0.24	2.4
7½,	6.4	5.9	0.33	3.3	6.5	6.2	0.21	3.5	6.8	6.4	0.36	3.6
10,	8.5	7.9	0.44	4.4	8.7	8.2	0.28	4.6	9.1	8.6	0.48	4.9
12½,	10.6	9.9	0.55	5.5	10.9	10.3	0.35	5.8	11.4	10.7	0.60	6.2
15,	12.7	11.9	0.66	6.6	13.0	12.4	0.42	6.9	13.9	12.9	0.72	7.4
17½,	14.8	13.9	0.77	7.7	15.2	14.2	0.49	8.1	16.0	15.0	0.84	8.6
20,	16.9	15.8	0.88	8.8	17.4	16.5	0.56	9.2	18.2	17.2	0.96	9.8
25,	21.2	19.8	1.10	11.0	21.7	20.6	0.70	11.6	22.8	21.5	1.20	12.3
Hays.	Kentucky blue grass hay, 1:10.6.				Rowen hay (mixed), 1:5.6.				Rowen hay (fine), 1:4.7.			
2½,	1.9	1.7	0.09	1.0	2.1	1.9	0.20	1.1	2.2	2.0	0.24	1.1
5,	3.7	3.4	0.19	2.1	4.2	3.8	0.40	2.3	4.3	4.0	0.49	2.3
7½,	5.6	5.0	0.28	3.0	6.3	5.7	0.60	3.4	6.5	6.0	0.73	3.4
10,	7.4	6.7	0.37	3.9	8.3	7.7	0.80	4.5	8.7	8.0	0.97	4.6
12½,	9.2	8.4	0.46	4.9	10.4	9.5	1.00	5.6	10.9	10.0	1.21	5.7
15,	11.1	10.1	0.56	5.9	12.5	11.4	1.20	6.7	13.0	12.1	1.46	6.8
17½,	13.0	11.7	0.65	6.9	14.6	13.4	1.40	7.8	15.2	14.1	1.70	8.0
20,	14.8	13.4	0.74	7.9	16.7	15.3	1.60	8.9	17.4	16.1	1.94	9.1
25,	18.5	16.8	0.93	9.9	20.9	19.2	2.00	11.2	21.7	20.1	2.43	11.4

TABLE II.—POUNDS OF TOTAL DRY MATTER, TOTAL ORGANIC MATTER AND DIGESTIBLE INGREDIENTS—*Continued.*

Pounds of Fodder.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.
Dry fodders.	Corn fodder, 1:14.3.				Corn stover, 1:23.6.				Oat hay, 1:9.9.			
2½,	1.4	1.4	0.06	0.9	1.5	1.4	0.04	0.8	2.3	2.1	0.10	1.0
5,	2.9	2.8	0.13	1.8	3.0	2.8	0.07	1.7	4.6	4.2	0.21	2.0
7½,	4.3	4.1	0.19	2.7	4.5	4.2	0.11	2.5	6.8	6.4	0.31	3.0
10,	5.8	5.5	0.25	3.6	6.0	5.7	0.14	3.3	9.1	8.5	0.41	4.0
12½,	7.2	6.9	0.32	4.5	7.5	8.1	0.18	4.1	11.4	10.6	0.51	5.1
15,	8.7	8.3	0.38	5.4	9.0	8.5	0.21	5.0	13.7	12.7	0.62	6.1
17½,	10.1	9.6	0.44	6.2	10.5	9.9	0.25	5.8	16.0	14.9	0.72	7.1
20,	11.6	11.0	0.50	7.1	12.0	11.3	0.28	6.6	18.2	17.0	0.82	8.1
25,	14.5	13.8	0.63	8.9	15.0	14.1	0.35	8.3	22.2	21.2	1.03	10.2
Hays.	Oat and pea hay, 1:4.1.				Hungarian, 1:10.0.				Red clover hay, 1:5.9.			
2½,	2.2	2.0	0.28	1.2	2.1	1.9	0.12	1.2	2.1	2.0	0.18	1.0
5,	4.4	4.1	0.56	2.3	4.2	3.9	0.25	2.4	4.2	3.9	0.36	2.1
7½,	6.6	6.1	0.84	3.5	6.3	5.9	0.37	3.6	6.4	5.9	0.53	3.2
10,	8.9	8.2	1.12	4.6	8.4	7.8	0.49	4.9	8.5	7.9	0.71	4.2
12½,	11.1	10.2	1.40	5.8	10.4	9.7	0.62	6.2	10.6	9.8	0.89	5.2
15,	13.3	12.3	1.68	6.9	12.5	11.7	0.74	7.4	12.7	11.8	1.07	6.3
17½,	15.5	14.3	1.96	8.1	14.6	13.6	0.86	8.6	14.8	13.7	1.24	7.3
20,	17.7	16.4	2.24	9.2	16.7	15.6	0.98	9.8	16.9	15.7	1.42	8.3
25,	22.1	20.5	2.80	11.6	20.9	19.5	1.23	12.3	21.2	19.6	1.78	10.5
Hays, etc.	Alsike clover hay, 1:5.5.				Clover rowen hay, 1:4.9.				Barley straw, 1:61.0.			
2½,	2.3	2.1	0.21	1.2	2.3	2.1	0.21	1.0	2.1	2.0	0.02	1.1
5,	4.5	4.1	0.42	2.3	4.6	4.2	0.43	2.1	4.3	4.0	0.04	2.1
7½,	6.8	6.2	0.63	3.5	6.9	6.4	0.64	3.2	6.4	6.0	0.05	3.2
10,	9.0	8.2	0.84	4.6	9.2	8.5	0.85	4.2	8.6	8.0	0.07	4.3
12½,	11.3	10.3	1.05	5.8	11.5	10.6	1.07	5.2	10.7	10.0	0.09	5.3
15,	13.5	12.3	1.26	6.9	13.8	12.7	1.28	6.3	12.9	12.0	0.11	6.4
17½,	15.8	14.3	1.47	8.1	16.0	14.8	1.49	7.3	15.0	14.0	0.12	7.5
20,	18.1	16.4	1.68	9.2	18.3	16.9	1.70	8.3	17.2	16.0	0.14	8.5
25,	22.6	20.5	2.10	11.6	22.9	21.2	2.13	10.5	21.5	20.0	0.19	10.7

TABLE II.—POUNDS OF TOTAL DRY MATTER, TOTAL ORGANIC MATTER AND DIGESTIBLE INGREDIENTS—*Continued.*

Pounds of Fodder.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.
Straws.	Oat straw, 1:38.3.				Wheat straw, 1:69.0.				Rye straw, 1:69.0.			
2½,	2.3	2.1	0.03	1.2	2.3	2.1	0.01	0.9	2.3	2.2	0.02	1.0
5,	4.6	4.3	0.06	2.3	4.5	4.3	0.02	1.9	4.6	4.5	0.03	2.1
7½,	6.8	6.4	0.09	3.5	6.8	6.4	0.03	2.8	7.0	6.7	0.05	3.1
10,	9.1	8.6	0.12	4.6	9.0	8.6	0.04	3.7	9.3	9.0	0.06	4.1
12½,	11.4	10.7	0.15	5.8	11.3	10.7	00.5	4.6	11.6	11.2	0.08	5.2
15,	13.9	12.9	0.18	6.9	13.5	12.9	0.06	5.6	13.9	13.4	0.09	6.2
17½,	16.0	15.0	0.21	8.1	15.8	15.0	0.07	6.5	16.3	15.7	0.11	7.2
20,	18.2	17.2	0.24	9.2	18.1	17.2	0.08	7.4	18.7	17.9	0.12	8.3
25,	22.7	21.5	0.30	11.5	22.6	21.6	0.10	9.3	23.2	22.4	0.15	10.4
Grains.	Corn meal, 1:11.3.				Corn and cob meal, 1:13:9:				Oats, 1:6.2.			
¼,	0.2	0.2	0.02	0.2	0.2	0.2	0.01	0.2	0.2	0.2	0.02	0.1
½,	0.4	0.4	0.03	0.4	0.4	0.4	0.02	0.3	0.4	0.4	0.05	0.3
1,	0.9	0.8	0.06	0.7	0.9	0.8	0.05	0.7	0.9	0.9	0.09	0.6
3.	1.7	1.7	0.10	1.4	1.7	1.7	0.10	1.3	1.8	1.7	0.18	1.1
3,	2.6	2.5	0.19	2.1	2.6	2.5	0.14	2.0	2.7	2.6	0.28	1.7
4,	3.4	3.3	0.25	2.9	3.4	3.3	0.19	2.7	3.6	3.4	0.37	2.3
5,	4.3	4.2	0.32	3.6	4.3	4.2	0.24	3.4	4.5	4.3	0.46	2.8
7½,	6.4	6.3	0.48	5.4	6.4	6.3	0.36	5.1	6.7	6.5	0.69	4.3
10,	8.5	8.4	0.63	7.1	8.5	8.4	0.48	6.7	8.9	8.6	0.92	5.7
Grains, etc.,	Provender, (½ ½) 1:8.4.				Provender (as sold in New England), 1:9.4.				Oat hulls, 1:18.2.			
¼,	0.2	0.2	0.02	0.2	0.2	0.2	0.02	0.2	0.2	0.2	0.01	0.1
½,	0.4	0.4	0.04	0.3	0.4	0.4	0.03	0.3	0.5	0.4	0.02	0.3
1,	0.9	0.9	0.08	0.6	0.9	0.9	0.07	0.6	0.9	0.9	0.03	0.5
2,	1.7	1.7	0.15	1.3	1.8	1.7	0.14	1.3	1.9	1.7	0.05	0.9
3,	2.6	2.6	0.23	1.9	2.7	2.6	0.20	1.9	2.8	2.6	0.08	1.4
4,	3.5	3.4	0.31	2.6	3.5	3.4	0.27	2.5	3.7	3.4	0.10	1.9
5,	4.4	4.3	0.39	3.2	4.4	4.3	0.34	3.2	4.6	4.3	0.13	2.4
7½,	6.5	6.4	0.58	4.9	6.6	6.5	0.51	4.8	7.0	6.5	0.20	3.5
10,	8.7	8.5	0.77	6.5	8.8	8.8	0.68	6.4	9.3	8.6	0.26	4.7

TABLE II.—POUNDS OF TOTAL DRY MATTER, TOTAL ORGANIC MATTER AND DIGESTIBLE INGREDIENTS—*Continued.*

Pounds of Fodder.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.
By-products, etc.	Quaker dairy feed, 1:4.6.				H. O. dairy feed, 1:3.3.				Victor corn and oat feed, 1:10.1.			
¼,	0.2	0.2	0.03	0.1	0.2	0.2	0.04	0.1	0.2	0.2	0.02	0.2
½,	0.5	0.4	0.05	0.3	0.5	0.4	0.07	0.2	0.5	0.4	0.03	0.3
1,	0.9	0.9	0.11	0.5	0.9	0.9	0.15	0.5	0.9	0.9	0.06	0.6
2,	1.8	1.7	0.22	1.0	1.8	1.7	0.29	1.0	1.8	1.7	0.13	1.3
3,	2.8	2.6	0.33	1.5	2.7	2.6	0.44	1.5	2.7	2.6	0.19	1.9
4,	3.7	3.5	0.44	2.0	3.6	3.5	0.59	2.0	3.6	3.4	0.25	2.5
5,	4.6	4.4	0.55	2.5	4.6	4.4	0.74	2.5	4.5	4.3	0.32	3.2
7½,	6.9	6.5	0.82	3.8	6.8	6.5	1.10	3.7	6.8	6.5	0.47	4.8
10,	9.2	8.7	1.09	5.0	9.1	8.7	1.47	4.9	9.0	8.6	0.63	6.4
By-products, etc.	H. O. horse feed, 1:6.4.				Barley, 1:8.0.				Barley screenings, 1:7.7.			
¼,	0.2	0.2	0.02	0.1	0.2	0.2	0.02	0.2	0.2	0.2	0.02	0.2
½,	0.5	0.4	0.05	0.3	0.4	0.4	0.0.	0.3	0.4	0.4	0.04	0.3
1,	0.9	0.9	0.09	0.6	0.9	0.9	0.09	0.7	0.9	0.8	0.09	0.7
2,	1.8	1.7	0.18	1.2	1.8	1.7	0.17	1.4	1.8	1.7	0.17	1.3
3,	2.7	2.6	0.28	1.8	2.7	2.6	0.26	2.1	2.6	2.5	0.26	2.0
4,	3.6	3.5	0.37	2.4	3.6	3.5	0.35	2.8	3.5	3.4	0.34	2.7
5,	4.5	4.4	0.46	2.9	4.5	4.4	0.44	3.5	4.4	4.2	0.43	3.3
7½,	6.8	6.5	0.69	4.4	6.7	6.5	0.65	5.2	6.6	6.3	0.65	6.0
10,	9.0	8.7	0.92	5.9	8.9	8.7	0.87	6.9	8.8	8.4	0.86	6.6
By-products.	Wheat bran, 1:3.8.				Wheat middlings, 1:4.6.				Wheat screenings, 1:5.2.			
¼,	0.2	0.2	0.03	0.1	0.2	0.2	0.03	0.1	0.2	0.2	0.02	0.1
½,	0.4	0.4	0.06	0.2	0.4	0.4	0.06	0.3	0.4	0.4	0.05	0.2
1,	0.9	0.8	0.12	0.5	0.9	0.9	0.13	0.6	0.9	0.9	0.10	0.5
2,	1.8	1.6	0.24	1.0	1.8	1.7	0.25	1.2	1.8	1.7	0.20	1.0
3,	2.6	2.5	0.36	1.4	2.6	2.6	0.38	1.7	2.7	2.6	0.29	1.5
4,	3.5	3.3	0.48	1.8	3.5	3.4	0.50	2.3	3.5	3.4	0.39	2.0
5,	4.4	4.1	0.60	2.3	4.4	4.3	0.63	2.9	4.4	4.3	0.49	2.5
7½,	6.6	6.2	0.90	3.4	6.6	6.4	0.94	4.4	6.6	6.5	0.74	3.8
10,	8.8	8.2	1.20	4.6	8.8	8.6	1.25	5.8	8.8	8.6	0.98	5.1

TABLE II.—POUNDS OF TOTAL DRY MATTER, TOTAL ORGANIC MATTER AND DIGESTIBLE INGREDIENTS—*Continued.*

Pounds of Fodder.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.
By-products.	Mixed (wheat) feed, 1:3.9.				Red-dog flour, 1:3.3.				Rye, 1:7.8.			
¼,	0.2	0.2	0.03	0.1	0.2	0.2	0.04	0.1	0.2	0.2	0.02	0.2
½,	0.4	0.4	0.07	0.3	0.5	0.4	0.09	0.3	0.4	0.4	0.04	0.3
1,	0.9	0.8	0.13	0.5	0.9	0.9	0.18	0.6	0.9	0.9	0.09	0.7
2,	1.8	1.7	0.27	1.0	1.8	1.7	0.36	1.2	1.8	1.7	0.18	1.4
3,	2.7	2.5	0.40	1.5	2.7	2.6	0.53	1.7	2.7	2.6	0.27	2.1
4,	3.6	3.3	0.53	2.1	3.6	3.5	0.71	2.3	3.5	3.5	0.36	2.8
5,	4.5	4.3	0.67	2.6	4.6	4.4	0.89	2.9	4.4	4.4	0.46	3.5
7½,	6.7	6.3	1.00	3.8	6.8	6.5	1.34	4.4	6.6	6.5	0.67	5.2
10,	8.9	8.4	1.33	5.2	9.1	8.7	1.78	5.8	8.8	8.7	0.89	6.9
By-products.	Rye bran, 1:5.1.				Cottonseed meal, 1:1.0.				Cottonseed feed, 1:5.6.			
¼,	0.2	0.2	0.03	0.2	0.2	0.2	0.10	0.1	0.2	0.2	0.02	0.1
½,	0.4	0.4	0.06	0.3	0.5	0.4	0.20	0.2	0.4	0.4	0.04	0.2
1,	0.9	0.9	0.12	0.6	0.9	0.9	0.40	0.4	0.9	0.9	0.08	0.4
2,	1.8	1.7	0.25	1.3	1.8	1.7	0.80	0.8	1.8	1.1	0.16	0.9
3,	2.7	2.6	0.37	1.9	2.8	2.6	1.20	1.2	2.7	2.6	0.25	1.3
4,	3.5	3.4	0.49	2.5	3.7	3.4	1.60	1.6	3.5	3.4	0.32	1.8
5,	4.4	4.3	0.62	3.1	4.6	4.3	2.00	2.0	4.4	4.3	0.40	2.2
7½,	6.6	6.4	0.92	4.7	6.9	6.4	3.00	3.0	6.6	6.4	0.59	3.3
10,	8.8	8.5	1.23	6.3	9.2	8.5	4.00	4.0	8.8	8.5	0.79	4.4
By-products.	Cottonseed hulls,——				Linseed meal (O. P.), 1:1.5.				Linseed meal (N. P.), 1:1.3.			
¼,	0.2	0.2	......	0.1	0.2	0.2	0.08	0.1	0.2	0.2	0.08	0.1
½,	0.4	0.4	......	0.2	0.5	0.4	0.15	0.2	0.4	0.4	0.16	0.2
1,	0.9	0.9	......	0.4	0.9	0.8	0.31	0.5	0.9	0.8	0.32	0.4
2,	1.8	1.7	......	0.7	1.8	1.7	0.62	1.0	1.8	1.7	0.65	0.8
3,	2.7	2.6	......	1.1	2.7	2.5	0.92	1.4	2.7	2.5	0.97	1.3
4,	3.6	3.4	......	1.5	3.6	3.4	1.23	1.8	3.6	3.4	1.30	1.7
5,	4.5	4.3	......	1.8	4.9	4.2	1.54	2.3	4.5	4.2	1.62	2.1
7½,	6.7	6.5	......	2.7	6.8	6.3	2.31	3.4	6.7	6.3	2.43	3.2
10,	8.9	8.6	......	3.7	9.0	8.4	3.08	4.6	8.9	8.4	3.25	4.2

TABLE II. POUNDS OF TOTAL DRY MATTER, TOTAL ORGANIC MATTER AND DIGESTIBLE INGREDIENTS—*Continued.*

Pounds of Fodder.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.
By-products.	Flax meal, 1:1.4.				Gluten meal (Chicago) 1:1.5.				Gluten meal (Cream).			
¼,	0.2	0.2	0.08	0.2	0.2	0.2	0.08	0.1	0.2	0.2	0.07	0.1
½,	0.4	0.4	0.16	0.2	0.4	0.4	0.16	0.2	0.4	0.4	0.15	0.2
1,	0.9	0.8	0.32	0.4	0.9	0.9	0.32	0.5	0.9	0.9	0.29	0.5
2,	1.8	1.7	0.64	0.9	1.8	1.7	0.64	0.9	1.8	1.8	0.59	1.0
3,	2.7	2.5	0.96	1.3	2.6	2.6	0.96	1.4	2.7	2.7	0.89	1.5
4,	3.6	3.4	1.28	1.7	3.5	3.4	1.28	1.9	3.6	3.6	1.19	2.1
5,	4.5	4.2	1.60	2.2	4.4	4.3	1.60	2.3	4.5	4.5	1.49	2.6
7½,	6.7	6.3	2.40	3.3	6.6	6.5	2.40	3.5	6.7	6.7	2.43	3.9
10,	8.9	8.4	3.21	4.3	8.8	8.6	3.21	4.7	9.0	8.9	2.97	5.1
By-products.	Gluten meal (King), 1:1.9.				Gluten feed (Buffalo or Marshalltown), 1:2.4.				Gluten feed (Diamond or Rockford) 1:3.0.			
¼,	0.2	0.2	0.07	0.1	0.2	0.2	0.06	0.1	0.2	0.2	0.05	0.2
½,	0.5	0.5	0.15	0.3	0.4	0.4	0.12	1.3	0.5	0.4	0.10	0.3
1,	0.9	0.9	0.30	0.6	0.9	0.9	0.23	0.6	0.9	0.9	0.20	0.6
2,	1.9	1.7	0.59	1.1	1.8	1.8	0.47	1.1	1.8	1.8	0.41	1.2
3,	2.8	1.8	0.89	1.7	2.7	2.6	0.70	1.7	2.7	2.7	0.61	1.9
4,	3.7	3.7	1.19	2.3	3.6	3.5	0.93	2.3	3.6	3.6	0.81	2.5
5,	4.6	4.6	1.49	2.8	4.5	4.4	1.17	2.8	4.6	4.5	1.02	3.1
7½,	6.9	6.9	2.23	4.3	6.8	6.6	1.75	4.3	6.8	6.8	1.52	4.7
10,	6.3	9.2	2.97	5.7	9.0	8.8	2.33	5.7	9.1	9.0	2.03	6.2
By-products.	Hominy chop, 1:9.2.				Starch feed, wet, 1:4.9.				Dried brewers grains, 1:3.0.			
¼,	0.2	0.2	0.02	0.2	0.1	0.1	0.01	0.1	0.2	0.2	0.04	0.1
½,	0.5	0.4	0.04	0.4	0.2	0.2	0.03	0.2	0.5	0.4	0.08	0.3
1,	0.9	0.9	0.09	0.8	0.3	0.3	0.05	0.3	0.9	0.9	0.16	0.5
2,	1.8	1.8	0.17	1.6	0.7	0.6	0.11	0.5	1.8	1.8	0.31	0.9
3,	2.8	2.7	0.26	2.4	1.0	1.0	0.16	0.8	2.8	2.6	0.47	1.4
4,	3.7	3.6	0.35	3.2	1.4	1.4	0.22	1.1	3.7	3.5	0.63	1.9
5,	4.6	4.5	0.44	4.0	1.7	1.7	0.27	1.3	4.6	4.4	0.79	2.4
7½,	6.9	6.7	0.65	6.0	2.6	2.6	0.41	1.7	6.9	6.6	1.18	3.5
10,	9.2	8.9	0.87	8.0	3.5	3.4	0.54	2.6	9.2	8.8	1.57	4.7

TABLE II.—POUNDS OF TOTAL DRY MATTER, TOTAL ORGANIC MATTER AND DIGESTIBLE INGREDIENTS—*Continued.*

Pounds of Fodder.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Total dry matter.	Organic matter.	Protein.	Carbohydrates, etc.	Carbohydrates, etc.	Protein.	Organic matter.	Total dry matter.
By-products.	Atlas gluten meal, 1:2.6.				Malt sprouts, 1:2.2.				Pea meal, 1:3.2.			
¼,	0.2	0.2	0.06	0.2	0.2	0.2	0.05	0.1	0.2	0.2	0.04	0.1
½,	0.5	0.4	0.12	0.3	0.4	0.4	0.09	0.2	0.4	0.4	0.08	0.3
1,	0.9	0.9	0.25	0.6	0.9	0.8	0.19	0.4	0.9	0.9	0.17	0.5
2,	1.8	1.8	0.49	1.3	1.8	1.7	0.37	0.8	1.8	1.7	0.33	1.1
3,	2.8	2.7	0.74	1.9	2.7	2.5	0.56	1.2	2.7	2.6	0.50	1.6
4,	3.7	3.6	0.98	2.6	3.6	3.3	0.74	1.6	3.6	3.5	0.67	2.1
5,	4.6	4.5	1.23	3.2	4.5	4.2	0.93	2.0	4.5	4.4	0.84	2.7
7½,	6.9	6.7	1.85	4.9	6.7	6.3	1.40	3.0	6.7	6.5	1.26	4.0
10,	9.2	9.0	2.46	6.5	9.0	8.4	1.86	4.0	9.0	8.7	1.68	5.3

AVERAGE COMPOSITION OF FEEDING STUFFS.

Taken from Bulletin No. 16, Prepared by Enos H. Hess, of the State Experiment Station, State College, Pa.

The following table is taken from "Rational Stock Feeding," by H. P. Armsby, with a few additions from the New Jersey report of 1894:

"The figures for the percentage composition are taken, in nearly every case, from the compilations of analysis of American feeding stuffs prepared by Drs. Jenkins and Winton, of the Connecticut Station, for the Office of Experiment Stations of the United States Department of Agriculture. The figures for the percentages of digestible matter, contained in the last five columns of the table, have been calculated from the average results of American digestion experiments, as compiled by Director Jordan of the Maine Station for the Office of Experiment Stations. In those cases in which no American results were available, the average results of German digestion experiments have been used, and in cases where no results were available the digestibility has been estimated from that of other feeding stuffs of similar composition and properties. These latter cases are distinguished by being closed in parenthesis in the table.

"Under percentages of digestible matter are given, first, the percentages of digestible protein, carbhydrates and fat; second, in the column headed 'total,' the percentage of total digestible matter reduced to its 'starch equivalent.' A pound of fat has been shown to be about two and one-fourth times as valuable as a pound of carbhydrates for the production of heat or force in the body; consequently the percentage of fat has been multiplied by two and one-fourth and the percentages of carbhydrates and protein added to give the figures under the heading 'total' in the next to the last column of the table. By the nutritive ratio of a feeding stuff is meant the ratio of digestible protein to other digestible matter, the latter having been reduced to its starch equivalent. Thus, the first feeding stuff given in the table contains 1.1 per cent. of digestible protein and 12.3 per cent. of total digestible matter calculated to its starch equivalent. Subtracting the 1.1 per cent. of protein, we have left 11.2 per cent. of other digestible matters, consequently the ratio of digestible protein to other digestible matters is 1.1:11.2, or 1:10.2, as given in the last column of the table.

Average Composition of Feeding Stuffs.

	Number of analyses.	Percentage Composition.						Per cent. of Digestible Matter.				
		Water.	Ash.	Protein.	Crude fibre.	Nitrogen-free extract.	Fat.	Protein.	Carbhydrates.	Fat.	Total.†	Nutritive ratio.
Soiling Fodder.												
Corn—dent, cut before glazing,	54	[illegible]	1.2	1.7	5.4	11.5	0.5	1.1	11.8	0.4	[illegible]	1:11.5
Cow pea,	10	83.6	1.7	2.4	4.8	7.1	0.4	1.6	7.0	0.2	9.1	1: 4.7
Crimson clover (just heading),*	2	[illegible]	1.2	2.5	1.8	4.9	0.4	1.7	4.4	0.2	6.6	1: 2.9
Crimson clover (full bloom),*	6	[illegible]	1.5	3.2	5.1	8.1	0.6	2.2	8.2	0.3	11.1	1: 4.1
Oats,	5	[illegible]	2.5	3.4	11.2	19.3	1.4	(2.7)	(22.3)	(1.0)	(27.3)	(1: 9.1)
Orchard grass in bloom,*	[illegible]	[illegible]	2.0	2.6	8.2	13.3	[illegible]	1.8	15.5	0.6	18.7	1: 9.4
Pasture grass,*	17	[illegible]	2.8	4.7	6.5	14.5	[illegible]	[illegible]	16.2	0.8	21.5	1: 5.2
Red clover,	43	[illegible]	2.1	4.4	8.1	13.5	1.1	[illegible]	13.3	0.7	17.9	1: 5.0
Rye,	6	82.0	1.6	2.4	4.8	8.5	0.7	1.9	9.8	0.5	12.8	1: 5.7
Soja bean,	6	71.8	2.4	[illegible]	[illegible]	11.5	1.0	([illegible])	(10.0)	(0.7)	(13.9)	(1: 5.0)
Silage.												
Corn silage—kernels glazing or more mature,	14	72.1	1.4	2.1	[illegible]	16.4	1.3	1.1	15.7	1.1	19.3	1:16.5
Red clover,	5	72.0	2.6	4.2	8.4	11.6	1.2	(2.8)	(3.5)	(0.8)	(18.1)	(1: 5.5)
Hay, Straw, Etc.												
Alfalfa hay,	21	[illegible]	7.4	14.3	25.0	42.7	2.2	[illegible]	40.5	1.1	53.4	1: 4.1
Corn fodder—field cured,	35	42.2	2.7	4.5	14.3	34.7	1.6	2.5	33.4	1.2	38.6	1:14.4
Corn stover*—field cured,	60	[illegible]	3.4	3.8	19.7	31.9	1.1	[illegible]	33.4	0.6	36.8	1:17.4
Clover hay—red,	38	15.3	6.2	12.3	24.8	38.1	[illegible]	[illegible]	34.9	1.6	44.9	1: 6.0
Hungarian grass, hay,*	12	7.7	6.0	7.5	27.7	49.0	2.1	[illegible]	46.7	1.0	53.2	1:11.4
Mixed meadow grass hay,*	11	[illegible]	4.6	6.4	29.9	41.0	2.1	3.6	42.9	[illegible]	[illegible]	1:12.6
Mixed hay,	...	14.3	5.3	9.1	26.9	41.5	2.9	4.7	39.3	1.5	47.4	1: 9.1
Oat straw,	12	9.2	5.1	4.0	37.0	42.4	2.3	1.4	43.9	0.9	47.3	1:32.8
Orchard grass hay,	10	9.9	6.0	8.1	32.4	41.0	2.6	4.8	42.0	1.4	50.0	1: 9.4
Red top hay,	9	8.9	5.2	7.9	28.6	47.5	1.9	4.8	46.9	1.0	54.0	1:10.3
Rye straw,	7	7.1	3.2	3.0	38.9	46.6	1.2	0.6	40.6	0.4	43.1	1:69.2
Timothy hay,	68	13.2	4.4	5.9	29.0	45.0	2.5	2.9	43.7	1.4	49.8	1:16.2
Wheat straw,	7	9.6	4.2	3.4	38.1	43.4	1.3	0.6	38.2	0.5	39.9	1:65.5
Roots and Tubers.												
Carrots,	8	88.6	1.0	1.1	1.3	7.6	0.4	([illegible])	(8.2)	(0.3)	(9.8)	(1: 9.9)
Mangel wurzels,	9	[illegible]	1.1	1.1	0.9	5.5	0.2	1.1	5.4	....	6.5	1: 4.9
Potatoes,	12	[illegible]	1.0	2.1	0.6	17.3	0.1	[illegible]	15.7	....	16.6	1:17.4
Rutabagas,	4	[illegible]	1.2	1.2	1.3	7.5	0.2	1.0	8.1	0.2	9.5	1: 8.5
Sugar beets,	19	[illegible]	0.9	1.8	0.9	9.8	0.1	1.6	10.7	0.1	12.5	1: 6.8
Turnips,	3	90.5	0.8	1.1	1.2	6.2	0.2	[illegible]	7.2	0.2	8.7	1: 7.7
Grain.												
Barley,	10	[illegible]	2.4	12.4	2.7	69.8	1.8	[illegible]	65.6	1.6	77.9	1: 8.0
Buckwheat,	8	12.6	2.0	10.0	8.7	64.5	2.2	([illegible])	(59.7)	(1.8)	(62.6)	(1: 7.0)
Corn—dent,	86	[illegible]	1.5	10.3	2.2	70.4	[illegible]	[illegible]	64.8	4.6	81.4	1:12.1
Corn—flint,	68	11.3	1.4	10.5	1.7	70.1	[illegible]	[illegible]	54.5	4.6	81.2	1:11.9
Corn—sweet,	26	8.8	1.9	11.6	2.8	66.8	8.1	[illegible]	61.5	7.5	85.4	1:11.2
Oats,	30	[illegible]	3.0	11.8	9.5	59.7	5.0	[illegible]	47.3	2.6	62.4	1: 5.8
Peas,		14.4	2.7	22.6	5.4	53.0	1.9	18.8	51.2	1.0	72.3	1: 2.8
Rye,	6	[illegible]	1.9	10.6	1.7	72.5	1.7	([illegible])	(66.7)	(1.6)	(76.7)	(1:11.0)
Sorghum seed,	10	12.7	2.1	9.0	2.6	70.0	[illegible]	([illegible])	(64.4)	(3.3)	(72.2)	(1:13.3)
Wheat—spring,	13	[illegible]	1.9	12.5	1.8	71.2	2.2	([illegible])	(65.5)	(2.0)	(77.5)	(1: 9.3)
Wheat—winter,	262	[illegible]	1.8	11.8	1.8	72.0	2.1	([illegible])	(66.2)	(1.9)	(77.6)	(1: 9.9)
Wheat—winter raised in Pennsylvania,	41	10.7	1.6	11.8	1.7	72.2	[illegible]	(7.1)	(66.4)	(1.8)	(77.6)	1: 9.9

Average Composition of Feeding Stuffs—Continued.

	Number of analyses.	Percentage Composition. Water.	Ash.	Protein.	Crude fibre.	Nitrogen-free extract.	Fat.	Per cent. of Digestible Matter. Protein.	Carbhydrates.	Fat.	Total.†	Nutritive ratio.
Mill Products.												
Barley meal, ...	3	11.9	2.6	10.5	6.5	66.3	2.2	7.4	64.3	2.0	76.2	1: 9.3
Corn meal, ...	77	15.0	1.4	9.2	1.9	68.7	3.8	5.5	63.2	3.5	76.6	1:12.9
Corn-and-cob meal,	7	15.1	1.5	8.5	6.6	64.8	3.5	4.4	60.0	2.9	70.9	1:15.1
Peal meal, ...	2	10.5	2.6	20.2	14.4	51.1	1.2	16.8	51.7	0.6	69.9	1: 3.2
Rye bran, ...	7	11.6	3.6	14.7	3.5	63.8	2.8	(11.5)	(44.3)	(2.0)	(60.3)	(1: 4.2)
Wheat bran, ...	88	11.9	5.8	15.4	9.0	53.9	4.0	12.0	38.9	2.9	57.4	1: 3.8
Wheat middlings,..	32	12.1	3.3	15.6	4.6	60.4	4.0	12.8	53.2	3.4	73.7	1: 4.8
Wheat shorts, ...	12	11.8	4.6	14.9	7.4	56.8	4.5	12.2	50.0	3.8	70.8	1: 4.8
By-Product and Waste Material.												
Apple pomace, ...	7	76.7	0.5	1.4	3.9	16.2	1.3					
Brewers' grains—dried, ...	3	8.2	3.6	[illegible]	[illegible]	[illegible]	5.6	(1.1)	(16.4)	....	(17.5)	(1:14.9)
Brewers' grains—wet, ...	15	75.7	1.6	5.4	3.8	12.5	1.6	15.7	36.3	5.1	63.5	1: 3.0
Buckwheat middlings, ...	3	13.2	4.8	28.9	4.0	42.0	7.1	4.3	9.4	1.5	17.1	1: 3.0
Cerealine food,*	3	6.9	2.6	10.6	6.8	62.3	8.1	(23.7)	(37.0)	(6.0)	(74.2)	(1: 2.1)
Corn oil meal, ...	3	9.0	2.4	24.8	6.7	43.6	13.5	9.0	53.4	6.6	77.3	1: 7.8
Corn cobs, ...	18	10.7	1.4	2.4	30.1	54.9	0.5	21.1	38.2	10.9	83.8	1: 3.1
Cotton seed hulls,..	4	10.4	2.6	4.0	44.4	36.6	2.0	0.4	52.5	0.3	53.6	1:33.0
Cotton seed meal,..	35	8.2	7.2	42.3	5.6	23.6	13.1	0.4	31.5	1.5	35.3	1:87.3
Gluten meal, ...	32	9.6	0.7	29.4	1.6	52.4	6.3	37.2	15.1	12.7	80.9	1: 1.2
Buffalo gluten								25.6	47.7	5.5	85.7	1: 2.4
meal, ...	1	7.8	1.0	21.8	6.7	52.7	10.0	18.5	45.6	8.1	82.3	1: 3.4
Chicago gluten meal, ...	1	11.1	1.2	35.1	0.7	45.0	6.9	30.5	41.0	6.1	85.2	1: 1.8
Cream gluten meal,	1	8.1	1.2	38.4	3.3	32.8	16.2	33.4	29.8	14.3	95.4	1: 1.9
Grano gluten feed,*	3	6.0	2.7	31.0	11.4	34.7	14.2	26.4	33.0	11.5	85.3	1: 2.3
Germ meal,*	1	29.6	11.1	21.7	2.9	45.8	29.6	(13.0)	(43.8)	(26.7)	(116.9)	....
Linseed meal—new								28.9	38.8	2.7	73.8	1: 1.6
process, ...	14	10.1	5.8	33.2	9.5	38.4	3.0	29.3	32.7	7.0	77.8	1: 1.7
Linseed meal—old process, ...	21	9.2	5.7	32.9	8.9	35.4	7.9					
Malt sprouts, ...	4	10.2	5.7	23.2	10.7	48.5	1.7	18.6	36.5	1.7	58.9	1: 2.2
Dairy Products.												
Buttermilk, ...	24	91.8	0.8	2.8	......	4.3	0.3	2.8	4.3	0.3	7.8	1: 1.8
Milk, ...	......	87.3-	0.7	3.1	....	5.1	3.8	3.1	5.1	3.8	16.8	1: 4.4
Skim-milk, ...	303	90.5	0.8	3.5	......	4.8	0.4	3.5	4.8	0.4	9.2	1: 1.6
Whey, ...	......	93.0	0.8	0.8	......	5.0	0.4	0.8	5.0	0.4	6.7	1: 7.4

†The fat reduced to its starch equivalent by multiplying by 2.25.

*Taken from the New Jersey report for 1894.

HOW TO COMPUTE A RATION.

The method of computing a ration is very simple if one knows how to do it, but "know how" is often very difficult to learn. It will be explained in as simple terms as possible in order that all who read carefully may learn how.

We will take a ration that contains 45 pounds ensilage, 5 pounds clover hay and 6 pounds buckwheat middlings. By referring to the table showing the composition of feeding stuffs, we find that these three foods contain the following amounts of digestible matter:

	Total dry matter.	Present Digestible Matter.			Nutritive ratio.
		Protein.	Carbhydrates.	Fat.	
Ensilage—kernels glazing or more matured, ..	27.9	1.1	15.7	1.1	1:16.5
Clover hay—red, ...	84.7	6.4	34.9	1 6	1: 6.0
Buckwheat middlings, ...	86.8	(23.7)	(37.0)	(6.0)	(1: 2.1)

There is 72.1 per cent. of water in ensilage; to determine the amount of dry matter we subtract the amount of water it contains from 100, which leaves us 27.9 per cent. of dry matter. (See table.) The dry matter is obtained in this way for clover hay and buckwheat middlings or any other food you may wish to compute the analysis of.

The figures in the above table give the amount of digestible food in one pound of the different materials. In 45 pounds of ensilage there would be 45 times as much; in 5 pounds of clover hay there would be 5 times as much; and in 6 pounds of buckwheat middlings there would be 6 times as much digestible food as is given in the table. Multiplying these figures by 45, 5 and 6 respectively, we get the following:

	Fresh weight.	Total dry matter.	Protein.	Carbhydrates.	Fat.	Total digestible matter.	Nutritive ratio.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		
Ensilage,	45	12.56	.50	7.08	.50	8.08	....
Clover hay,	5	4.24	.32	1.75	.08	2.15	....
Buckwheat middlings,	6	5.21	1.42	2.22	.36	4.00	....
Total,	....	22.01	2.24	11.05	.94	14.23	1: 5.9
Reduced for a cow weighing 1,000 pounds,	....	22.69	2.31	11.39	.97	14.23	1: 5.9
Wolff's German standard,	....	24.00	2.50	12.50	.40	15.40	1: 5.40

The cows receiving this ration are assumed to weigh 970 pounds. Other things being equal, the heavier the cow the more food she will need. The standard ration gives the amount of food required for a cow weighing 1,000 pounds. Therefore, in order to compare this ration with the standard it has to be reduced by dividing by .970. This quotient gives the amount of digestible food that would be required for a cow weighing 1,000 pounds on the same basis. It will be seen that it does not contain as much total dry matter, protein, carbhydrates and total digestible matter as the German standard; but more fat and the nutritive ratio is wider.

HOW TO CALCULATE THE NUTRITIVE RATIO AND TOTAL DIGESTIBLE MATTER.

If we burn a pound of coal we know that there is a certain amount of heat produced. If this heat be applied to water there will be a given quantity of the water converted into steam. Compress this steam and we get power by which we can run a threshing machine or lift a weight.

If we burn protein, carbhydrates or fat we will also get a certain amount of power if the heat is applied to water. We will assume that the burning of one pound of protein will produce enough power to lift one pound one foot from the ground. The carbhydrates have about the same power; but the power produced by burning one pound of fat is two and one-fourth times as great. That is to say, on the same basis, we multiply the amount of fat by two and one-

fourth feet from the ground or two and one-fourth pounds one foot from the ground. In order to have the protein, carbhydrates and fat, if one pound of fat were burned it would lift one pound two and one-fourth feet, and add this product to the amount of carbhydrates and divide the sum obtained, by the protein. The quotient will be the ratio. In the above ration there is .94 pound of fat. This multiplied by 2¼ equals 2.12 pounds; add to this amount the 11.05 pounds of carbhydrates and we have 13.17 pounds. Divide this amount by 2.24 (the amount of protein), and we get a quotient of 5.9, which equals the ratio of 1:5.9. That is to say, there is one pound of protein or milk and muscle forming food to 5.9 pounds of carbhydrates and fat or heat and fat forming foods.

AVERAGE PENNSYLVANIA PRICES FOR FEEDING STUFFS.

In a subjoined table is given as near as possible the average selling price of the different feeding stuffs for the past ten years. It was next to impossible to get figures for so long a time on some of the feeds. In these cases the present prices were taken. The cost of all the rations are based on the figures given in this table; in the case of hay, corn stover and other products of the farm the prices given are somewhat below the market price, and in the case of the by-products that have to be brought, the prices given are slightly higher than the market price. This was done in order to make allowance for the expense of hauling to or from the farm:

	Price per Ton.	Price per Lb.
Barley meal,	$20 00	1.0
Brewers' grains (dry),	14 00	0.7
Buckwheat meal,	20 00	1.0
Buckwheat middlings,	18 00	.9
Clover hay,	9 00	0.45
Cerealine food,	12 00	.6
Corn-and-cob meal,	15 00	9.75
Corn meal,	19 00	0.95
Corn silage,	2 00	.1
Corn stover,	5 00	0.25
Cotton seed meal,	26 00	1.3
Gluten meal,	18 00	.9
Gluten meal,	18 00	0.90
Gluten meal (Buffalo),	18 00	.9
Gluten meal (Atlas),	18 00	.9
Green rye,	2 00	.1
Hominy meal,	14 00	.7
Linseed meal,	26 00	1.3
[illegible]	[illegible]	1 1
[illegible]	2 [illegible]	.1
Meadow hay,	11 00	0.55
Millet hay,	8 00	.4
Mixed hay,	10 00	.5
Oat meal,	22 00	1.1
Oat straw,	5 00	0.25
Potatoes,	5 00	0.25
Rutabagas,	3 00	0.15
Skimmed milk,	3 60	0.18
Timothy hay,	11 00	0.55
Wheat bran,	18 00	.9
Wheat chaff,	5 00	0.25
Wheat middlings,	19 00	0.95
Wheat shorts,	19 00	0.95
Wheat straw,	5 00	0.25

FEEDING STANDARDS.

From Bulletin No. 22, Department of Agriculture, Washington, D. C.

Attempts have been made to ascertain the food requirements of various kinds of farm animals under different conditions. Large numbers of feeding experiments have been made under varying conditions with this end in view. From the results, feeding standards have been worked out which show the amounts of digestible protein, fat, and carbhydrates supposed to be best adapted to different animals when kept for different purposes. The feeding standards of Wolff, a German, have been most widely used. They are as follows:

Wolff's Feeding Standards.

A.—Per Day and Per 1,000 Pounds Live Weight.

	Total organic matter.	Digestible Food Materials. Protein.	Carbhydrate.	Fat.	Fuel value.
	Pounds.	Pounds.	Pounds.	Pounds.	Calories.
Oxen at rest in stall,	17.5	0.7	8.0	0.15	16,815
Wool sheep, coarser breeds,	20.0	1.2	10.3	0.20	22,235
Wool sheep, finer breeds,	22.5	1.5	11.4	0.25	25,050
Oxen moderately worked,	24.0	1.6	11.3	0.30	21,260
Oxen heavily worked,	26.0	2.4	13.2	0.50	31,126
Horses moderately worked,	22.5	1.8	11.2	0.60	26,712
Horses heavily worked,	25.5	2.8	13.4	0.80	33,508
Milch cows,	24.0	2.5	12.5	0.40	2[illegible],590
Fattening steers:					
First period,	27.0	2.5	15.0	0.50	34,66[illegible]
Second period,	26.0	3.0	14.8	0.70	36,062
Third period,	25.0	2.7	14.8	0.60	35,082
Fattening sheep:					
First period,	26.0	3.0	15.2	0.50	35,962
Second period,	25.0	3.5	14.4	0.60	35,826
Fattening swine:					
First period,	36.0	5.0		27.5	60,450
Second period,	31.0	4.0		24.0	52,080
Third period,	23.5	2.7		17.5	37,570

B.—Per Day and Per Head.

	Average live weight per head.	Total organic matter.	Digestible Food Materials. Protein.	Carbhydrates.	Fat.	Fuel value.
Growing cattle:						
Age—						
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Calories.
2 to 3 months,	150	3.3	0.6	2.1	0.30	5,116
3 to 6 months,	300	7.0	1.0	4.1	0.30	10.750
6 to 12 months,	500	12.0	1.3	6.8	0.30	16,332
12 to 18 months,	700	16.8	1.4	9.1	0.28	2[illegible],712
18 to 24 months,	850	20.4	1.4	10.3	0.26	22,859
Growing sheep:						
Age—						
5 to 6 months,	56	1.6	0.18	0.87	0.045	2,14[illegible]
6 to 8 months,	67	1.7	0.17	0.85	0.040	2,066
8 to 11 months,	75	1.7	0.16	0.85	0.037	2,035
11 to 15 months,	82	1.8	0.14	0.89	0.032	2,0[illegible]1
15 to 20 months,	85	1.9	0.12	0.88	0.025	1,9[illegible]6
Growing fat swine:						
Age—						
2 to 3 months,	50	2.1	0.38		1.50	3,496
3 to 5 months,	100	3.4	0.50		2.50	5,[illegible]80
5 to 6 months,	125	3.9	0.54		2.96	6 5[illegible]0
6 to 8 months,	170	4.6	0.58		3.47	7 533
8 to 12 months,	250	5.2	0.62		4.05	8,686

FERTILIZING CONSTITUENTS OF AMERICAN FEEDING STUFFS AND MANURIAL VALUE PER TON.

Taken from Bulletin No. 16, Prepared by Enos H. Hess, of the State Experiment Station, Pennsylvania.

In commercial fertilizers there are only three ingredients which are assumed to have any practical value, namely: Nitrogen, phosphoric acid and potash. The foods used in feeding dairy cattle contain more or less of these three ingredients, and, therefore, have a fertilizing value equal to the amount of nitrogen, phosphoric acid and potash they contain. The nitrogen is valued at twelve cents per pound, the phosphoric acid at four cents and potash at five cents per pound. No allowance is made for the value of the humus, which has some value, but as to how much it has, will have to be left to the judgment of the reader, for as yet it has not been scientifically determined.

	Pounds in 100 Pounds.			Manurial Value in Dollars per Ton.			
	Nitrogen.	Phosphoric acid.	Potash.	Nitrogen.	Phosphoric acid.	Potash.	Total.
SOILING FODDER.	Lbs.	Lbs.	Lbs.				
Corn—dent, cut before glazing,	0.41	0.14	0.33	$0.984	$0.120	$0.33	$1.43
Cow pea,	0.27	0.10	0.31	.648	.080	.31	1.01
Crimson clover (just heading),*	0.40	0.12	0.34	.960	.096	.34	1.40
Crimson clover (full bloom),*	0.51	0.12	0.35	1.224	.096	.35	1.67
Orchard grass (in bloom),	0.43	0.16	0.76	1.032	.128	.76	1.92
Pasture grass,*	0.75	0.19	0.60	1.800	.152	.60	2 55
Red clover,	0.53	0.13	0.46	1.272	.104	.46	1.84
Rye,	0.33	0.15	0.73	.792	.120	.73	1.64
Soja bean,	0.29	0.15	0.53	.696	.120	.53	1.35
SILAGE.							
Corn silage—average of all analyses,	0.28	0.11	0.37	.672	.088	.37	1.13
Red clover,	0.53	0.13	0.46	1.272	.104	.46	1.84
HAY, STRAW, ETC.							
Alfalfa hay,	2.19	0.51	1.68	5.256	.458	1.68	7.34
Corn fodder—field cured,	1.76	0.54	0.89	4.225	.432	.89	5.55
Corn stover—field cured,	1.04	0.29	1.40	2.496	.232	1.40	4.13
Clover hay—red,	2.07	0.38	2.20	4.968	.304	2.20	7.47
Hungarian grass hay,	1.20	0.35	1.30	2.880	.280	1.30	4.46
Mixed meadow grass hay,*	1.02	0.26	1.48	2.448	.208	1.48	4.14
Mixed hay,	1.67	0.46	1.55	4.009	.368	1.55	5.93
Oat straw,	0.62	1.24	1.24	1.488	.160	1.24	2.89
Orchard grass hay,	1.31	0.01	1.88	3.144	.328	1.88	5.35
Red top hay,	1.15	0.36	1.02	2.760	.288	7.02	4.07
Rye straw,	0.46	0.28	0.79	1.104	.224	.79	2.12
Timothy hay,	1.26	0.53	0.90	3.024	.424	.90	4.35
Wheat straw,	0.59	0.70	0.42	1.896	.560	.42	2.88
Wheat chaff,	0.79	0.70	0.42	1.896	.560	.42	2.88

*Taken from New Jersey report for 1894.

Fertilizing Constituents of American Feeding Stuffs and Manurial Value Per Ton—Continued.

	Pounds in 100 Pounds.			Manurial Value in Dollars per Ton.			
	Nitrogen.	Phosphoric acid.	Potash.	Nitrogen.	Phosphoric acid.	Potash.	Total.
ROOTS AND TUBERS.	Lbs.	Lbs.	Lbs.				
Carrots,	0.15	0.09	0.51	.361	.072	.51	.94
Mangel wurzels,	0.19	0.09	0.38	.456	.072	.38	.91
Potatoes,	0.21	0.07	0.29	.504	.056	.29	.85
Rutabagas,	0.19	0.12	0.49	.456	.096	.49	1.04
Sugar beets,	0.22	0.10	0.48	.528	.080	.39	.90
Turnips,	0.18	0.10	0.39	.432	.080	.39	.90
GRAIN.							
Barley,	1.51	0.79	0.48	3.625	.632	.48	4.74
Buckwheat,	1.44	0.44	0.21	3.456	.352	.21	4.02
Corn—dent,*	1.65	0.70	0.40	$3.961	$0.560	$0.40	$4.92
Corn—flint,*	1.68	0.70	0.40	4.033	.560	.40	4.99
Corn—sweet,*	1.82	0.72	0.41	4.369	.576	.41	5.36
Oats,	2.06	0.82	0.62	4.945	.656	.62	6 22
Peas,	3.08	0.82	0.99	7.393	.656	.99	9.04
Rye,	1.76	0.82	0.54	4.225	.656	.54	5.42
Sorghum seed,	1.48	0.81	0.42	3.553	.648	.42	4.62
Wheat—spring,	2.36	0.70	0.39	5.665	.500	.39	6.62
Wheat—winter,	2.36	0.89	0.61	5.665	.712	.61	6.99
MILL PRODUCTS.							
Barley meal,	1.55	0.66	0.34	3.720	.528	.34	4.59
Buckwheat middlings,	4.62	1.73	1.56	11.088	1.384	1.560	14.032
Corn meal,	1.58	0.63	0.40	3.792	.504	.40	4.70
Corn-and-cob meal,	1.41	0.57	0.47	3.384	.456	.47	4.31
Pea meal,	3.08	0.82	0.99	7.392	.656	.99	9.04
Rye bran,	2.32	2.28	1.40	5.568	1.824	1.40	8.79
Wheat bran,	2.67	2.89	1.61	6.408	2.312	1.61	10.33
Wheat middlings,	2.63	0.95	0.63	6.312	.760	.63	7.70
Wheat shorts,*	2.42	1.38	0.65	5.808	1.404	.65	7.56
BY-PRODUCTS AND WASTE MATERIAL.							
Apple pomace,	0.23	0.02	0.13	0.552	0.016	.013	0.70
Brewers' grains—dried,	3.05	1.26	1.55	7.320	1.008	1.55	9.88
Brewers' grains—wet,	0.89	0.31	0.05	2.136	.248	.05	2.43
Cerealine feed,*	1.69	1.25	0.67	4.056	1.000	.67	5.73
Corn oil meal,*	3.96	1.45	0.17	9.504	1.160	.17	10.83
Corn cobs,	0.50	0.06	0.60	1.200	.048	.60	1.85
Cottonseed hulls,	0.75	0.18	1.08	1.800	.144	1.08	3.02
Cottonseed meal,	6.64	2.68	1.79	15.936	2.144	1.79	19.87
Gluten meal,	5.03	0.33	0.05	12.072	.264	.05	12.39
Buffalo gluten feed,*	3.44	0.38	0.07	8.256	.304	.07	8.63
Chicago gluten meal,*	5.52	0.29	0.05	13.284	.232	.05	13.53
Grano gluten feed,*	4.96	0.66	0.20	11.904	.528	.20	12.63
Germ meal,*	3.48	6.16	2.91	8 352	4.928	2.91	16.19
Linseed meal—new process,	5.78	1.83	1.39	13.872	1.464	1.39	16.73
Linseed meal—old process,	5.43	1.66	1.37	13.032	1.328	1.37	15.73
Malt sprouts,	3.55	1.43	1.63	8.250	1.144	1.63	11 29
DAIRY PRODUCTS.							
Butter,	0.12	0.04	0.04	.238	.032	.04	.36
Buttermilk,	0.48	0.17	0.16	1.152	.136	.16	1.45
Cheese,	3.93	0.60	0.12	9.432	.480	.12	10.03
Cream,	0.40	0.15	0.13	.960	.120	.13	1.21
Milk,	0.53	0.19	0.18	1.272	.152	.18	1.60
Skim-milk,	0.56	0.20	0.19	1.344	.160	.19	1.69
Whey,	0.15	0.14	0.18	.360	.112	.18	.65

*Taken from New Jersey report for 1894.

The above table shows a very wide range in the fertilizing value of the different dairy foods and products. The highest value per ton is $19.87 for cotton seed meal and the lowest is 36 cents for butter. The importance of the fertilizing value of foods is, therefore, clearly seen and must be carefully studied if the maximum results are to be obtained.

MILK STATISTICS.

Taken from the Milk Reporter, Sussex, New Jersey.

TABLE I.

Report of Milk Received in Philadelphia for the Year 1901.

	Pennsylvania Railroad System.			Philadelphia & Reading.		Lehigh Valley via P. & R.	Baltimore and Ohio.	Wagons. Estimated.	Totals.
	Kensington.	Camden.	31st & Chestnut.	Camden.	Philadelphia.				
January,	8,240	1,619,120	[illegible]	72,320	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
February,	5,210	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
March,	7,620	[illegible]	1,738,420	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April,	7,280	1,751,880	[illegible]	75,140	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May,	[illegible]	1,996,110	1,912,930	71,180	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June,	[illegible]	1,967,420	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July,	[illegible]	[illegible]	1,872,530	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
August,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September,	[illegible]	1,807,392	[illegible]	62,460	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
October,	[illegible]	1,897,510	[illegible]	70,960	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
November,	[illegible]	[illegible]	[illegible]	62,720	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
December,	[illegible]	1,775,089	[illegible]	[illegible]	2,901,720	[illegible]	[illegible]	[illegible]	[illegible]
Totals,	71,379	*21,270,194	20,700,380	882,000	36,754,960	[illegible]	[illegible]	†[illegible]	[illegible]

*Total receipts (Federal Street, Camden, Penn. R. R. System) for Philadelphia and Camden, [illegible] quarts.

†Estimated.

NOTE.—Lebanon Valley Branch P. & R. R., 4,000,680 quarts included in Philadelphia receipts for Reading system.

TABLE II.

Report of Milk Received in Philadelphia from 1890 to 1901 Inclusive.

	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Penn. system,	*[illegible]	*[illegible]	*[illegible]	*[illegible]	*39,489,560	*40,043,280	38,202,133	37,101,100	38,090,530	[illegible]	39,820,550	42,041,944
Reading,	37,887,824	36,784,678	36,748,667	35,484,124	35,945,016	34,054,540	34,970,980	33,414,148	34,634,908	38,242,772	39,490,498	37,586,960
Lehigh Valley,	....	....	....	3,704,920	[illegible]	6,988,240	7,430,960	8,059,680	8,687,760	9,624,800	[illegible]	10,340,320
B. & O.,	5,420,340	5,005,752	5,687,300	6,055,040	6,548,508	6,133,824	6,874,840	6,384,412	6,105,884	5,880,392	6,029,436	[illegible]
Wagons,	10,600,000	10,600,000	10,600,000	10,000,000	9,500,000	[illegible]	[illegible]	[illegible]	[illegible]	7,200,000	7,200,000	[illegible]
Total quarts,	89,257,884	88,594,420	91,278,774	94,539,994	98,539,164	96,219,881	96,478,913	93,959,340	94,719,082	99,580,074	102,556,308	[illegible]

*Philadelphia and Camden receipts included.

TABLE III.

Average Monthly and Yearly Price of Milk and Butter from 1896 to 1900 Inclusive. Also the Number of Quarts of Milk Required to Purchase One Pound of Butter.

	1897.			1898.			1899.			1900.			1901.		
	Average price milk.	Average price butter.	Quarts milk.	Average price milk.	Average price butter.	Quarts milk.	Average price milk.	Average price butter.	Quarts milk.	Average price milk.	Average price butter.	Quarts milk.	Average price milk.	Average price butter.	Quarts milk.
January,	2.75	20	7.3	2.75	20.4	7.4	2.75	19.75	7.2	3	26.25	8.75	3	[illegible].9	7.6
February,	*2.63	20.5	7.8	*2.6	20	7.7	2.5	21	8.4	3	25	8.33	2.75	[illegible].5	8.2
March,	†2.37	19.3	8.15	†2.38	19.38	8.1	2.5	21	8.4	2.75	25	[illegible]	*2.63	[illegible]	8.4
April,	‡2.13	18.5	8.7	2.25	19.25	8.5	2.25	19.6	8.72	2.50	19.6	7.84	2.50	21	8.4
May,	2	15	7.5	‡2.12	16.3	7.7	*2.12	18	8.5	*2.29	20	8.7	†2.12	[illegible]	9
June,	1.75	15	8.6	1.75	17	9.7	2	18.75	9.4	2.25	19.3	8.6	2.00	[illegible].5	9.75
July,	§1.94	15	7.7	2	17.13	8.57	†2.17	18.3	8.4	†2.44	19.5	8	2.25	[illegible].75	8.8
August,	2	16.7	8.35	2.25	19	8.44	2.25	20	9	‡2.63	21	8	‡2.36	[illegible].4	8.6
September,	2.25	19	8.44	§2.45	20	8.2	2.5	22.75	9.1	2.75	21.7	7.9	2.50	[illegible].8	8.32
October,	2.5	22.25	8.9	2.5	22	8.8	‡2.85	24	8.4	3	21.2	7	2.75	[illegible]	8
November,	‖2.83	22.6	8	‖2.63	23.4	8.9	3.25	26	8	3	25.75	8.58	§3.08	[illegible].1	7.82
December,	3	22.6	7.5	3	21	7	3.25	27.2	8.[illegible]7	3.25	25.2	7.75	3.50	[illegible].1	7.17
Average price per year,	2.35	18.87	8	2.38	19.57	8.2	2.53	21.36	8.41	2.74	22.1	[illegible]	2.62	21.59	8.34

1897:
* 1 15 2 75
16 28 2 50
† 1 15 2 50
16 31 2 25
‡ 1 15 2 25
16 30 2 00
§ 1 15-1 875
16 31 2 00
‖ 1 20 2 75
21 30 3 00

1898:
* 1 11 2 75
12 28 2 50
† 1 15 2 50
16 31 2 25
‡ 1 15 2 25
16 31 2 00
§ 1 6 2 25
7 30 2 50
‖ 1 15 2 50
16 30 3 00

1899:
* 1 15 2 25
16 31 2 00
† 1 10 2 00
1 31 2 25
‡ 1 19 2 75
20 3 3 00

1900:
* 1 15 2 50
16 31 2 25
† 1 15 2 375
16 31 2 50
‡ 1 5 2 50
16 31 2 75

1901:
* 1 15 2 75
16 31 2 50
† 1 15 2 25
16 31 2 00
‡ 1 17 2 25
18 31 2 50
§ 20 3 00
21 30 3 25

FIFTY DAIRY RULES.

From the Report of the Bureau of Animal Industry of the United States in 1898.

The Owner and His Helpers.

1. Read current dairy literature and keep posted on new ideas.

2. Observe and enforce the utmost cleanliness about the cattle, their attendants, the stable, the dairy, and all utensils.

3. A person suffering from any disease, or who has been exposed to a contagious disease, must remain away from the cows and the milk.

The Stable.

4. Keep dairy cattle in a room or building by themselves. It is preferable to have no cellar below and no storage loft above.

5. Stables should be well ventilated, lighted, and drained; should have tight floors and walls and be plainly constructed.

6. Never use musty or dirty litter.

7. Allow no strongly smelling material in the stable for any length of time. Store the manure under cover outside the cow stable and remove it to a distance as often as practicable.

8. Whitewash the stable once or twice a year. Use land plaster in the manure gutters daily.

9. Use no dry, dusty feed just previous to milking; if fodder is dusty, sprinkle it before it is fed.

10. Clean and thoroughly air the stable before milking. In hot weather sprinkle the floor.

11. Keep the stable and dairy room in good condition, and then insist that the dairy, factory, or place where the milk goes be kept equally well.

The Cows.

12. Have the herd examined at least twice a year by a skilled veterinarian.

13. Promptly remove from the herd any animal suspected of being in bad health and reject her milk. Never add an animal to the herd until certain it is free from disease, especially tuberculosis.

14. Do not move cows faster than a comfortable walk while on the way to place of milking or feeding.

15. Never allow the cows to be excited by hard driving, abuse, loud

talking or unnecessary disturbance; do not expose them to cold or storm.

16. Do not change the feed suddenly.

17. Feed liberally, and use only fresh, palatable feed stuffs; in no case should decomposed or moldy material be used.

18. Provide water in abundance, easy of access, and always pure; fresh, but not too cold.

19. Salt should always be accessible.

20. Do not allow any strong-flavored food, like garlic, cabbage, and turnips, to be eaten, except immediately after milking.

21. Clean the entire body of the cow daily. If hair in the region of the udder is not easily kept clean it should be clipped.

22. Do not use the milk within twenty days before calving nor within three to five days afterwards.

Milking.

23. The milker should be clean in all respects; he should not use tobacco; he should wash and dry his hands just before milking.

24. The milker should wear a clean outer garment; used only when milking, and kept in a clean place at other times.

25. Brush the udder and surrounding parts just before milking, and wipe them with a clean, damp cloth or sponge.

26. Milk quietly, quickly, cleanly and thoroughly. Cows do not like unnecessary noise or delay. Commence milking at exactly the same hour every morning and evening, and milk the cows in the same order.

27. Throw away (but not on the floor, better in the gutter) the first few streams from each teat; this milk is very watery and of little value, but it may injure the rest.

28. If in any milking a part of the milk is bloody or stringy or unnatural in appearance, the whole mess should be rejected.

29. Milk with dry hands; never allow the hands to come in contact with the milk.

30. Do not allow dogs, cats, or loafers to be around at milking time.

31. If any accident occurs by which a pail full or partly full of milk becomes dirty, do not try to remedy this by straining, but reject all this milk and rinse the pail.

32. Weigh and record the milk given by each cow, and take a sample morning and night, at least once a week, for testing by the fat test.

Care of Milk.

33. Remove the milk of every cow at once from the stable to a clean, dry room, where the air is pure and sweet. Do not allow cans to remain in stables while they are being filled.

34. Strain the milk through a metal gauze and a flannel cloth or layer of cotton as soon as it is drawn.

35. Aerate and cool the milk as soon as strained. If an apparatus for airing and cooling at the same time is not at hand, the milk should be aired first. This must be done in pure air, and it should then be cooled to 45 degrees if the milk is for shipment, or to 60 degrees if for home use or delivery to a factory.

36. Never close a can containing warm milk which has not been aerated.

37. If cover is left off can, a piece of cloth or mosquito netting should be used to keep out insects.

38. If milk is stored, it should be held in tanks of fresh, cold water (renewed daily), in a clean, dry, clad room. Unless it is desired to remove cream, it should be stirred with a tin stirrer often enought to prevent forming a thick cream layer.

39. Keep the night milk under shelter so rain can not get into the cans. In warm weather hold in a tank of fresh cold water.

40. Never mix fresh warm milk with that which has been cooled.

41. Do not allow milk to freeze.

42. Under no circumstances should anything be added to milk to prevent its souring. Cleanliness and cold are the only preventatives needed.

43. All milk should be in good condition when delivered. This may make it necessary to deliver twice a day during the hottest weather.

44. When cans are hauled far they should be full, and carried in a spring wagon.

45. In hot weather cover the cans, when moved in a wagon, with a clean wet blanket or canvass.

The Utensils.

46. Milk utensils for farm use should be made of metal and have all joints smoothly soldered. Never allow them to become rusty or rough inside.

47. Do not haul waste products back to the farm in the same cans used for delivering milk. When this is unavoidable, insist that the skim milk or whey tank be kept clean.

48. Cans used for the return of skim milk or whey should be emptied and cleaned as soon as they arrive at the farm.

49. Clean all dairy utensils by first thoroughly rinsing them in warm water; then clean inside and out with a brush and hot water in which a cleaning material is dissolved; then rinse and lastly sterilize by boiling water or steam. Use pure water only.

50. After cleaning, keep utensils inverted, in pure air, and sun if possible, until wanted for use.

PERIOD OF GESTATION IN DOMESTIC ANIMALS.

FROM ANIMAL INDUSTRY. (*Shaw.*)

The average duration, approximately, of the period of gestation in domestic quadrupeds may be given as follows:

The ass,	365 days.	The sow,	113 days.
The mare,	330 days.	The dog,	63 days.
The cow,	282 days.	The cat,	50 days.
The sheep,	149 days.	The rabbit,	30 days.
The goat,	149 days.	The guinea-pig,	21 days.

The average duration, approximately, of the period in hatching the eggs of the various domestic breeds of fowls may be set down as follows:

The goose,	30 days.	The guinea-hen,	26 days.
The turkey,	29 days.	The hen,	21 days.
The duck,	29 days.	The pigeon,	18 days.
The pea-hen,	28 days.		

The extremes in the duration of the period of gestation in the mare, the cow, the ewe and the sow may be set down as follows:

The mare,	295 days to 370 days.
The cow,	265 days to 300 days.
The ewe,	145 days to 154 days.
The sow,	110 days to 118 days.

The extremes in the duration of the period of incubation in the various classes of domestic fowls named below may be given as follows:

The goose,	27 days to 33 days.
The turkey,	26 days to 30 days.
The duck,	26 days to 32 days.
The pea-hen,	28 days to 30 days.
The guinea-hen,	25 days to 26 days.
The pigeon,	16 days to 20 days.

THE FUNCTIONS AND USES OF FOODS.*

BY C. F. LANGWORTHY, PH. D., *Office of Experiment Stations.*

Circular No. 46, United States Department of Agriculture.

Ordinary food materials, such as meat, fish, eggs, potatoes, wheat, etc., consist of—

Refuse.—As the bones of meat and fish, shells of shellfish, skins of potatoes, bran of wheat, etc.

Edible portion.—As the flesh of meat and fish, the white and yolk of eggs, wheat flour, etc. The edible portion consists of water and nutritive ingredients, or nutrients. The nutritive ingredients are *protein*, *fats*, *carbohydrates*, and *mineral matters*.

The water, refuse, and salt of salted meat and fish are called non-nutrients. In comparing the values of different food materials for nourishment they are left out of account.

Use of Nutrients.

Food is used in the body to build and repair tissue and to furnish energy. The manner in which the valuable constituents are utilized in the body may be expressed in tabular form as follows:

Protein, White (albumen) of eggs, curd (casein) of milk, lean meat, gluten of wheat, etc.	Forms tissue (muscles, tendon, and probably fat)	All serve as fuel and yield energy in form of heat and muscular strength.
Fats, Fat of meat, butter, olive oil, oils of corn and wheat, etc.	Form fatty tissue	
Carbohydrates, Sugar, starch, etc.	Transformed into fat.	
Mineral matters (ash), Phosphates of lime, potash, soda, etc.	Aid in forming bone, assist in digestion, etc.	

*This article, which was originally published under the title "Foods for Man," in the U. S. Dept. Agr. Yearbook, 1897, pp. 676-692, has been revised and contains some additional matter.

The fuel value of food.—Heat and muscular power are forms of force or energy. The energy is developed as the food is consumed in the body. The unit commonly used in this measurement is the calorie, the amount of heat which would raise the temperature of a pound of water 4 degrees F.

Instead of this unit, some unit of mechanical energy might be

used—for instance, the foot-ton, which represents the force required to raise one ton one foot. One calorie is equal very nearly to 1.53 foot-tons.

The following general estimate has been made for the average amount of potential energy in one pound of each of the classes of nutrients:

	Calories.
In one pound of protein	1,860
In 1 pound of fats	4,220
In 1 pound of carbohydrates	1,860

In other words, when we compare the nutrients in respect to their fuel values, their capacities for yielding heat and mechanical power, a pound of protein of lean meat or albumen of egg is just about equivalent to a pound of sugar or starch, and a little over two pounds of either would be required to equal a pound of the fat of meat or butter or the body fat.

Within recent years analyses of a large number of samples of foods have been made in this country. In the table below the average results of a number of these analyses are given:

Average Composition of American Food Products. (*).

Food Materials (as purchased).	Refuse. Per cent.	Water. Per cent.	Protein. Per cent.	Fat. Per cent.	Carbohydrates. Per cent.	Ash. Per cent.	Fuel value per pound. Calories.
ANIMAL FOOD.							
Beef, fresh:							
Chuck, including shoulder,	17.3	54.0	15.8	12.5	....	0.7	820
Chuck ribs,	19.1	53.8	15.3	11.1	....	.8	755
Flank,	5.5	56.1	18.6	19.9	....	.8	1,185
Loin,	13.3	52.9	16.4	16.9	....	.9	1,020
Porterhouse steak,	12.7	52.4	19.1	17.9	....	.8	1,110
Sirloin steak,	12.8	54.0	16.5	16.1	....	.9	985
Neck,	31.8	45.3	14.2	9.2	....	.7	650
Ribs,	20.1	45.3	14.4	30.0	....	.7	1.110
Rib rolls,	....	64.8	19.4	15.5	....	.9	1,105
Round,	8.5	62.5	19.2	9.2	....	1.0	745
Rump,	19.5	46.9	15.2	18.6	....	.8	1,065
Shank, fore,	38.3	43.2	13.2	5.2	....	.6	465
Shoulder and clod,	17.4	57.0	16.5	8.4	....	.9	660
Fore quarter,	20.6	49.5	14.4	15.1	....	.7	905
Hind quarter,	16.3	52.0	16.1	15.4	....	.8	950
Beef, corned, canned, pickled, and dried:							
Corned beef,	8.4	49.2	14.3	23.8	....	4.6	1,271
Tongue, pickled,	6.0	68.9	11.9	19.2	....	4.3	1,030
Dried, salted and smoked,	4.7	53.7	26.4	6.9	....	8.9	780
Canned boiled beef,	....	51.8	25.5	22.5	....	1.3	1,425
Canned corned beef,	....	51.8	26.3	18.7	....	4.0	1.280
Veal:							
Breast,	23.3	52.5	15.7	8.2	....	.8	635
Leg,	11.7	63.4	18.3	5.8	....	1.0	585
Leg cutlets,	3.4	68.3	20.1	7.5	....	1.0	690
Fore quarter,	24.5	54.2	15.1	6.0	....	.7	535
Hind quarter,	20.7	56.2	16.2	6.6	....	.8	580
Mutton:							
Flank,	9.9	39.0	13.8	36.9	....	.6	1,815
Leg, hind,	17.7	51.9	15.4	14.5	....	.8	[illegible]
Shoulder,	22.1	46.8	13.7	17.1	....	.7	975
Fore quarter,	21.2	41.6	12.3	24.5	....	.7	1,265
Hind quarter, without tallow,	19.3	43.3	13.0	24.0	....	.7	1,255
Lamb:							
Breast,	19.8	45.5	15.4	19.1	....	.8	1,090
Leg, hind,	13.8	50.3	16.0	19.7	....	.9	1,130
Pork, fresh:							
Flank,	18.0	48.5	15.1	18.6	....	.7	1,065
Ham,	10.3	45.1	14.3	29.7	....	.8	1,520
Loin chops,	19.3	40.8	13.2	26.0	....	.8	1,340
Shoulder,	12.4	44.9	12.0	29.8	....	.7	1,480
Tenderloin,	....	66.5	18.9	13.0	....	1.0	900
Pork, salted, cured and pickled:							
Ham, smoked,	12.2	35.8	14.5	33.2	....	4.2	1,670
Shoulder, smoked,	18.9	30.7	12.6	33.0	....	5.0	1,625
Salt pork,	....	7.9	1.9	86.2	....	3.9	3,670
Bacon, smoked,	8.7	18.4	9.5	59.4	....	4.5	2,685
Sausage:							
Bologna,	3.3	55.2	18.2	19.7	....	3.8	1.170
Farmer,	3.9	22.2	27.9	40.4	....	7.3	2.225
Frankfort,	....	57.2	19.6	18.6	1.1	3.4	1.170
Soups:							
Celery, cream of,	....	88.6	2.1	2.8	5.0	1.5	250
Beef,	....	92.9	4.4	.4	1.1	1.2	120
Meat stew,	....	84.5	4.6	4.3	5.5	1.1	370
Tomato,	....	90.0	1.8	1.1	4.6	1.5	185
Poultry:							
Chicken, broilers,	41.6	43.7	12.8	1.4	....	.7	295
Fowls,	25.9	47.1	13.7	12.3	....	.7	775
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
Turkey,	22.7	42.4	16.1	18.4	....	.8	1.075
Fish:							
Cod, dressed,	29.9	58.5	11.1	.2	....	.8	215
Halibut, steaks or sections,	17.7	67.9	15.3	4.4	....	.9	470
Mackerel, whole,	44.7	40.0	10.2	4.2	....	.7	365
Perch, yellow, dressed,	35.1	50.7	12.8	.7	....	.9	265
Shad, whole,	50.1	35.2	9.4	4.8	....	.7	380
Shad, roe,	....	71.2	20.9	3.8	2.6	1.5	600
Fish, salt, cod,	24.9	40.2	16.0	.4	....	18.5	315

*Condensed from detailed tables in Bulletin No. 28, revised, of the Office of Experiment Stations of this Department.

Average Composition of American Food Products—Continued.

Food Materials (as purchased).	Refuse. Per cent.	Water. Per cent.	Protein. Per cent.	Fat. Per cent.	Carbohydrates. Per cent.	Ash. Per cent.	Fuel value per pound. Calories.
ANIMAL FOOD—Continued.							
Fish, canned:							
Salmon,	14.2	56.8	19.5	7.5	....	2.0	680
Sardines,	*5.0	53.6	23.7	12.1	....	5.3	950
Shellfish:							
Oyster, "solids,"	....	88.3	6.0	1.3	3.3	1.1	230
Clams,	....	80.8	10.6	1.1	5.2	2.3	340
Crabs,	52.4	36.7	7.9	.9	.6	1.5	195
Lobsters,	61.7	30.7	5.9	.7	.2	.8	140
Eggs: Hens' eggs,	†11.2	65.5	11.9	9.3	....	.9	635
Dairy products, etc.:							
Butter,	....	11.0	1.0	85.0	....	3.0	3,605
Whole milk,	....	87.0	3.3	4.0	5.0	.7	325
Skim milk,	....	90.5	3.4	.3	5.1	.7	170
Buttermilk,	....	91.0	3.0	.5	4.8	.7	165
Condensed milk,	....	26.9	8.8	8.3	54.1	1.9	1,520
Cream,	....	74.0	2.5	18.5	4.5	.5	910
Cheese, Cheddar,	....	27.4	27.7	36.8	4.1	4.0	2,145
Cheese, full cream,	....	34.2	25.9	33.7	2.4	3.8	1,950
VEGETABLE FOOD.							
Flour, meal, etc.:							
Entire wheat flour,	....	11.4	13.8	1.9	71.9	1.0	1,675
Graham flour,	....	11.3	13.3	2.2	71.4	1.8	1,670
Wheat flour, patent roller process:							
High grade and medium,	....	12.0	11.4	1.0	75.1	.5	1,650
Low grade,	....	12.0	14.0	1.9	71.2	.9	1,665
Macaroni,*	....	78.4	3.0	1.5	15.8	1.3	415
Crushed wheat,	....	10.1	11.1	1.7	75.5	1.6	1,685
Buckwheat flour,	....	13.6	6.4	1.2	77.9	.9	1,620
Corn meal,	....	12.5	9.2	1.9	75.4	1.0	1,655
Oatmeal,	....	7.3	16.1	7.2	67.5	1.9	1,860
Rice,	....	12.3	8.0	.3	79.0	.4	1,620
Tapioca,	....	11.4	.4	.1	88.0	.1	1,650
Starch,	....	....	....	....	90.0	....	1,675
Bread, pastry, etc.:							
White bread,	....	35.3	9.2	1.3	53.1	1.1	1,215
Brown bread,	....	43.6	5.4	1.8	47.1	2.1	1,050
Graham bread,	....	35.7	8.9	1.8	52.1	1.5	1,210
Whole wheat bread,	....	38.4	9.7	.9	49.7	1.3	1,140
Rye bread,	....	35.7	9.0	.6	53.2	1.5	1,180
Cake,	....	19.9	6.3	9.0	63.3	1.5	1,675
Cream crackers,	....	6.8	9.7	12.1	69.7	1.7	1,990
Oyster crackers,	....	4.8	11.3	10.5	70.5	2.9	1,965
Soda crackers,	....	5.9	9.8	9.1	73.1	2.1	1,925
Sugars, etc.:							
Molasses,	....	25.1	2.4	....	69.3	3.2	1,290
Candy,	....	....	....	....	96.0	....	1,785
Honey,‡	....	18.2	.4	....	81.2	.2	1,520
Sugar, granulated,	....	....	....	....	[illegible]	....	[illegible]
Maple syrup,	....	....	....	....	71.4	....	[illegible]
Vegetables:§							
Beans, dried,	....	12.6	22.5	1.8	59.6	3.5	1,605
Beans, Lima, shelled,	....	68.5	7.1	.7	22.0	1.7	570
Beans, string,	7.0	83.0	2.1	.3	6.9	.7	180
Beets,	20.0	70.0	1.3	.1	7.7	.9	170
Cabbage,	15.0	77.7	1.4	.2	4.8	.9	125
Celery,	20.0	75.6	.9	.1	2.6	.8	70
Corn, green (sweet), edible portion,	....	75.4	3.1	1.1	19.7	.7	470
Cucumbers,	15.0	81.1	.7	.2	2.6	.4	70
Lettuce,	15.0	80.5	1.0	.2	2.5	.8	75
Mushrooms,	....	88.1	3.5	.4	6.8	1.2	210
Onions,	10.0	78.9	1.4	.3	8.9	.5	205
Parsnips,	20.0	66.4	1.3	.4	10.8	1.1	240
Peas (Pisum sativum), dried,	....	9.5	24.6	1.0	62.0	2.9	1,655

*Refuse, oil.

†Refuse, shell.

‡Contained on an average, cane sugar 2.8 and reducing sugar 71.1 per cent. The reducing sugar was composed of about equal amounts of glucose (dextrose) and fruit sugar (levulose).

§Such vegetables as potatoes, squash, beets, etc., have a certain amount of inedible material, skin, seeds, etc. The amount varies with the method of preparing the vegetables, and can not be accurately estimated. The figures given for refuse of vegetables, fruits, etc., are assumed to represent approximately the amount of refuse in these foods as ordinary prepared.

Average Composition of Food Products.—Continued.

Food Materials (as purchased).	Refuse. Per cent.	Water. Per cent.	Protein. Per cent.	Fat. Per cent.	Carbohydrates. Per cent.	Ash. Per cent.	Fuel value per pound. Calories.
VEGETABLE FOOD—Continued.							
Vegetables: *—Continued.							
Peas (Pisum sativum), shelled,	....	74.6	7.0	0.5	16.9	1.0	465
Cowpeas, dried,	....	13.0	21.4	1.4	60.8	3.4	1,590
Potatoes,	20.0	62.6	1.8	.1	14.7	.8	310
Rhubarb,	40.0	56.6	.4	.4	2.2	.4	65
Sweet potatoes,	20.0	55.2	1.4	.6	21.9	.9	640
Spinach,	....	92.3	2.1	.3	3.2	2.1	110
Squash,	50.0	44.2	.7	.2	4.5	.4	105
Tomatoes,	....	94.3	.9	.4	3.9	.5	105
Turnips,	30.0	76.7	.9	.1	5.7	.6	125
Vegetables, canned:							
Peas (Pisum sativum), green,	....	85.3	3.6	.2	9.8	1.1	255
Corn, green,	....	76.1	2.8	1.2	19.0	.9	455
Tomatoes,	....	94.0	1.2	.2	4.0	.6	105
Fruits, berries, etc., fresh: †							
Apples,	25.0	63.4	.3	.3	10.8	.3	220
Bananas,	35.0	48.9	.8	.4	14.3	.6	300
Grapes,	25.0	58.0	1.0	1.2	14.4	.4	3 5
Lemons,	30.0	62.5	.7	.5	5.9	.4	145
Muskmelons,	50.0	44.8	.3	....	4.6	.3	90
Oranges,	27.0	63.4	.6	.1	8.5	.4	170
Pears,	10.0	76.0	.5	.4	12.7	.4	260
Persimmons, edible portion,	....	66.1	.8	.7	31.5	.9	630
Raspberries,	....	85.8	1.0	....	12.6	.6	255
Strawberries,	5.0	85.9	.9	.6	7.0	.6	175
Watermelons,	59.4	37.5	.2	.1	2.7	.1	60
Fruits, dried:							
Apples,	....	28.1	1.6	2.2	66.1	2.0	1,350
Apricots,	....	81.4	.9	....	17.3	.4	340
Dates,	10.0	13.8	1.9	2.5	70.6	1.2	1,450
Figs,	....	18.8	4.3	.3	74.2	2.4	1,475
Nuts:							
Almonds,	45.0	2.7	11.5	30.2	9.5	1.1	1,660
Beechnuts,	40.8	2.3	13.0	34.0	7.8	2.1	1,8 0
Brazil nuts,	49.6	2.6	8.6	33.7	3.5	2.0	1,655
Butternuts,	86.4	.6	3.8	8.3	.5	.4	430
Chestnuts, fresh,	16.0	37.8	5.2	4.5	35.4	1.1	945
Chestnuts, dried,	24.0	4.5	8.1	5.3	56.4	1.7	1,425
Cocoanuts,	‡48.8	7.2	2.9	25.9	14.3	.9	1,413
Cocoanut, prepared,	....	3.5	6.3	57.4	31.5	1.3	3,125
Filberts,	52.1	1.8	7.5	31.3	6.2	1.1	1,575
Hickory nuts,	62.2	1.4	5.8	25.5	4.3	.8	1,265
Pecans, polished,	53.2	1.4	5.2	33.3	6.2	.7	1,620
Peanuts,	24.5	6.9	19.5	29.1	18.5	1.5	1,935
Pinon (Pinus edulis),	40.6	2.0	8.7	36.8	10.2	1.7	1,905
Walnuts, California, black,	74.1	.6	7.2	14.6	3.0	.5	805
Walnuts, California, soft shell,	58.1	1.0	6.9	26.6	6.8	.6	1,375
Raisins,	10.0	13.1	2.3	3.0	68.5	3.1	1,445
Miscellaneous:							
Chocolate,	....	5.9	12.9	48.7	30.3	2.2	2,860
Cocoa, powdered,	....	4.6	21.6	28.9	37.7	7.2	2,320
Cereal coffee, infusion (1 part boiled in 20 parts water),‡	....	98.2	.2	....	1.4	.2	30

*Such vegetables as potatoes, squash, beets, etc., have a certain amount of inedible material, skin, seeds, etc. The amount varies with the method of preparing the vegetables, and can not be accurately estimated. The figures given for refuse of vegetables, fruits, etc., are assumed to represent approximately the amount of refuse in these foods as ordinarily prepared.

†Fruits contain a certain proportion of inedible materials, as skin, seeds, etc., which are properly classed as refuse. In some fruits, as oranges and prunes, the amount rejected in eating is practically the same as refuse. In others, as apples and pears, more or less of the edible material is ordinarily rejected with the skin and seeds and other inedible portions. The edible material which is thus thrown away, and should properly be classed with the waste, is here classed with the refuse. The figures for refuse here given represent, as nearly as can be ascertained, the quantities ordinarily rejected.

‡Milk and shell.

§The average of five analyses of cereal coffee grain is: Water 6.2, protein 13.3, fat 3.1, carbohydrates 72.6, and ash 4.5 per cent. Only a portion of the nutrients, however, enter into the infusion. The average in the table represents the available nutrients in the beverage. Infusions of genuine coffee and of tea like the above contain practically no nutrients.

Dietary Standards.

Dietary studies have been made in considerable numbers in different countries. The results of such studies and experiments to determine the amount of food required by men engaged in different occupations have resulted in the adoption of dietary standards. Some of these follow:

Standards for Daily Dietaries.

Character of Work to be Performed.	Nutrients. Protein. Pound.	Nutrients. Fat. Pound.	Nutrients. Carbohydrate. Pounds.	Fuel value. Calories.
European:				
Man at moderate work,	0.26	0.12	1.10	3.055
Man at hard work,	.32	.22	.99	3,370
American:				
Man without muscular work,	.2[illegible]	....	....	[illegible],000
Man with light muscular work,	.22	....	....	3,000
Man with moderate muscular work,	.28	....	....	3.500
Man with hard muscular work,	.39	....	....	4,500

The table of composition of food materials shows the amount of water, protein, fat, carbohydrates, and ash content and the total fuel value per pound for each kind of food named. The protein, fat, and carbohydrates all furnish energy. In addition to furnishing energy, protein forms tissue. Since protein and energy are the essential features of food, dietary standards may be expressed in their simplest form in terms of protein and energy alone.

Observation has shown that as a rule a woman requires less food than a man, and the amount required by children is still less, varying with the age. It is customary to assign certain factors which shall represent the amount of nutrients required by children of different ages and by women as compared with adult man. The various factors which have been adopted are as follows:

Factors used in Calculating Meals Consumed in Dietary Studies.

One meal of woman equivalent to 0.8 meal of man at moderate muscular labor.

One meal of boy 14 to 16 years of age, inclusive, equivalent to 0.8 meal of man.

One meal of girl 14 to 16 years of age, inclusive, equivalent to 0.7 meal of man.

One meal of child 10 to 13 years of age, inclusive, equivalent to 0.6 meal of man.

One meal of child 6 to 9 years of age, inclusive, equivalent to 0.5 meal of man.

One meal of child 2 to 5 years of age, inclusive, equivalent to 0.4 meal of man.

One meal of child under 2 years of age equivalent to 0.3 meal of man.

These factors are based in part upon experimental data and in part upon arbitrary assumptions. They are subject to revision when experimental evidence shall warrant more definite conclusions.

The plan followed in making dietary studies is, briefly, as follows: Exact account is taken of all the food materials (1) at the beginning of the study, (2) purchased during the study, and (3) remaining at the end. The difference between the third and the sum of the first and second is taken as representing the amount used. From the figures thus obtained the amount of the different food materials and the amount of the different nutrients furnished by them is calculated. Deducting from this the weights of the nutrients found in the kitchen and table refuse, the amounts actually consumed are obtained. Account is also taken of the meals eaten by different members of the family or groups studied and by visitors, if there are any. From the total food eaten by all the persons during the entire period the amount eaten per man per day may be calculated. In making these calculations due account is taken of the fact that, as stated above, women and children eat less than men performing the same amount of work.

Method of Calculating Dietaries.

The following may be taken as an illustration of the way in which the table of composition of food products and the dietary standards may be practically applied. Suppose the family consists of four adults, and that there are on hand or may be readily purchased the following food materials: Oatmeal, milk, sugar, eggs, lamb chops, roast beef, potatoes, sweet potatoes, rice, bread, cake, bananas, tea, and coffee. From these materials menus for three meals might be arranged as follows:

Breakfast.—Oatmeal, milk, sugar, lamb chops, bread, butter, and coffee.

Dinner.—Roast beef, potatoes (Irish), sweet potatoes, rice pudding, and tea.

Supper.—Bread, butter, cake, and bananas.

The amounts required of the several articles of food may be readily approximated by any person experienced in marketing or preparing food for a family. Thus, it may be assumed that four adults would consume for breakfast 1½ pounds lamb chops, one-half pound oatmeal, one-half pound bread, 6 ounces milk, 2 ounces sugar, and 2 ounces

butter. From the table of composition of food materials the nutritive ingredients which these foods furnish may be easily calculated. Thus, if oatmeal contains 16.1 per cent. of protein and furnishes 1,860 calories per pound, one-half pound would contain 0.081 pound protein ($0.5 \times 0.161 = 0.081$ pound) and yield 930 calories ($0.5 \times 1,860 = 930$), and if lamb chops contain 16 per cent. protein and furnish 1,130 calories per pound, 1½ pounds of lamb chops would furnish 0.24 pounds protein (1.5 pounds $\times$ 0.16 = 0.24 pound) and 1,695 calories (1.5 pounds $\times$ 1,130 = 1,695) calories. The others may be calculated in the same way.

The assumed quantities of food materials which the four persons would consume in a day, and the calculated protein content and fuel value, would be as follows:

Menu for Family of Four Adults for One Day.

Food Materials.	Weights. Pounds.	Weights. Ounces.	Protein. Pound.	Fuel value. Calories.
Breakfast.				
Oatmeal,	....	8	0.081	930
Milk,	....	6	.012	122
Sugar,	....	2	....	232
Lamb chops (from leg),	1	8	.240	1,695
Bread,	....	8	.046	6[illegible]8
Butter,	....	2	.001	451
Coffee,*	....	....	.010	417
Total,	....	....	.390	4,455
Dinner.				
Roast beef (chuck),	1	12	.277	1,435
Potatoes,	....	12	.014	233
Sweet potatoes,	....	12	.011	480
Bread,	....	6	.035	456
Butter,	....	2	.011	451
Rice,	....	4	.020	408
Eggs,	....	4	.060	160
Milk,	....	6	.012	122
Sugar,	....	2	....	232
Tea,	....	....	.010	410
Total,	....	....	.410	4,387
Supper.				
Bread,	....	12	.076	912
Butter,	....	2	.001	451
Bananas,	....	12	.006	225
Cake,	....	8	.032	[illegible]
Total,	....	....	[illegible]	2,426
Total for 3 meals,	....	....	.909	11,268
Average for 1 person,	....	....	.227	2,817

*Coffee and tea in themselves have little or no nutritive value. In the menu, allowance is made for the milk or cream and the sugar that would ordinarily be added.

The American dietary standard for a man at moderate muscular work calls for 0.28 pound protein and 3,500 calories. It will be seen that the menu suggested above is insufficient; that is, more food must be supplied. For instance, cheese might be added for dinner, and pork and beans and milk for supper. The amounts of protein and energy which a sufficient quantity of these articles for four persons would supply are shown in the following table:

Food Added to Bring the Day's Menu up to the Dietary Standard.

Food Materials.	Weights. Pounds.	Weights. Ounces.	Protein. Pound.	Fuel value. Calories.
Cheese,	....	4	0.069	536
Beans,	....	10	.141	1,005
Pork,	....	4	.005	918
Milk,	2	....	.066	6[illegible]0
Total amount added to menu,	....	....	.281	3,10[illegible]

These additions would make the total protein 1,190 pounds and the total fuel value of 14,377 calories for four persons, or for one person, 0,298 pound protein and 3,599 calories. (For the sake of simplifying calculations no distinction is made between the amounts required by men and women.) These values are approximately the amounts required by the dietary standard.

Following the above method, the value of any menu chosen may be easily calculated. It should be borne in mind that approximate rather than absolute agreement with the dietary standard is sought. It is not the purpose to furnish a prescription for definite amounts of food materials, but rather to supply the means of judging whether the food habits of families accord in general with what research has shown to be most desirable from a physiological standpoint. If economy is necessary, a study of the tables will show that it is possible to devise menus which will furnish the requisite amounts of nutrients and energy at comparatively low cost.

Digestibility.

The value of a food is determined not alone by its composition, but also by its digestibility; that is, by the amount of it which the body can retain and utilize as it passes through the digestive tract. The term digestibility, as frequently employed, particularly in popular articles, has several other significations. Thus, to many persons

it conveys the idea that a particular food "agrees" with the user, i. e., that it does not cause distress when eaten. The term is also very commonly understood to mean the ease or rapidity of digestion, and one food is often said to be more digestible than another because it is digested in less time. However, the term digestibility is most commonly understood in scientific treatises on the subject to mean thoroughness of digestion. The digestibility of any food may be learned most satisfactorily by experiments with man, although experiments are also made by methods of artificial digestion. In the experiments with man both food and feces are analyzed. Deducting the amounts of the several nutrients in the feces from the total amounts of each nutrient consumed shows how much of each was digested. The results are usually expressed in percentages and spoken of coefficients of digestibility. From a large number of experiments with man it has been calculated that on an average the different groups into which foods may for convenience be divided have the following coefficients of digestibility:

Coefficients of Digestibility of Different Groups of Foods.

	Protein. Per cent.	Fat. Per cent.	Carbohydrates. Per cent.	Mineral matters. Per cent.
Animal foods,	98	97	100	75
Cereals and sugars,	85	90	98	75
Vegetables and fruits,	80	90	95	75

Making use of these figures, the digestible nutrients furnished by any food may be readily calculated. Thus, as shown by the table on composition above, sirloin steak contains 16.5 per cent. protein. One and one-half pounds would therefore contain 0.2475 pound protein, or in round numbers, 0.25 pound ($1.5 \times 16.5 = 0.2475$). As shown by the coefficients of digestibility quoted above, 98 per cent. of the protein of animal food is digestible. Therefore, 1.5 pounds sirloin steak would furnish 0.245 pound digestible protein ($0.25 \times 0.98 = 0.245$). The digestibility of the several nutrients in a given quantity of any food may be calculated in a similar way.

TABLE OF WEIGHTS AND MEASURES IN PENNSYLVANIA.

Wheat, per bushel, 60 lbs. Act March 10, 1818.
Barley, per bushel, 47 lbs. Act March 10, 1818.
Buckwheat, per bushel, 48 lbs. Act March 10, 1818.
Corn, per bushel, 56 lbs. Act April 16, 1845.
Rye, per bushel, 56 lbs. Act April 16, 1845.
Oats, per bushel, 32 lbs. Act March 30, 1897.
Potatoes, per bushel, 56lbs. Act March 30, 1897.
Clover seed, per bushel, 60 lbs. Act June 26, 1895.
Onions, per bushel, 50 lbs. Act May 8, 1895.
Salt, coarse, per bushel, 85 lbs. Act March 10, 1818.
Salt, ground, per bushel, 70 lbs. Act March 10, 1818.
Salt, fine, per bushel, 62 lbs. Act March 10, 1818.
Salt, per barrel, evaporated, 280 lbs. Act March 24, 1877.
Bark, per cord, 2,000 lbs.
Bark, per ton, 2,000 lbs.

FREIGHT RATES TAKEN FROM STATISTICAL ABSTRACT OF THE UNITED STATES, 1901.

TABLE I.

Freight Rates on Wheat, by Lake, Canal and Sail, and Flour, by Rail, from Chicago to New York, and from New York to Liverpool, by Steam, 1860 to 1901.

(Prepared by J. C. Brown, Statistician, New York Produce Exchange.)

Calendar Year.	Wheat—Average rates per Bushel.			New York to Liverpool.
	By lake and canal.* Cents.	By lake and rail. Cents.	By all rail. Cents.	Pence.
1860	24.83	....	....	....
1861	26.55	....	....	....
1862	26.33	....	....	....
1863	22.91	....	....	....
1864	28.36	....	....	....
1865	26.62	....	....	....
1866	29.61	....	46.1	4 7-8
1867	22.36	....	44.2	5 3-16
1868	22.79	29	42.6	6 15-16
1869	25.12	25	35.1	6 11-16
1870	17.11	22	33.3	5 7-8
1871	20.24	25	31	8 1-4
1872	24.47	28	33.5	7 3-4
1873	19.19	26.9	33.2	10 9-16
1874	14.1	16.9	28.7	8 13-16
1875	11.43	14.6	24.1	9 7-16
1876	9.58	11.8	16.5	8
1877	11.24	15.8	20.3	7
1878	9.15	11.4	17.7	7 5-8
1879	11.6	13.3	17.3	6 3-16
1880	12.27	15.7	19.9	5 13-16
1881	8.19	10.4	14.4	4 1-8
1882	7.89	10.9	14.6	3 15-16
1883	8.37	11.5	16.5	4 5-16
1884	6.31	9.95	13.125	3 1-2
1885	5.87	9.02	14	3 3-16
1886	8.71	12	16.5	3 5-16
1887	8.51	12	15.74	2 1-2
1888	5.93	11	14.5	2 5-8
1889	6.89	8.7	15	3 15-16
1890	5.85	8.5	14.31	2 7-16
1891	5.96	8.53	15	3 1-8
1892	5.61	7.55	14.23	2 5-8
1893	6.33	8.44	14.7	2 3-8
1894	4.44	7	12.88	1 15-16
1895	4.11	6.95	12.17	2 9-16
1896	5.38	7.32	12	2 15-16
1897	4.35	7.37	12.32	3 1-16
1898	4.42	4.96	11.55	3 7-16
1899	5.65	6.63	11.13	2 7-16
1900	4.42	5.05	9.98	3 3-8
1901	5.14	5.57	9.92	1 1-4

*Including canal tolls until 1882, but not Buffalo transfer charges.
†Averages based upon officially published tariffs; actual rates lower.
‡For domestic consumption; local rate for export only $9.08 in 1900, and $9.02 in 1901.

TABLE II.

Freight Rates and Tolls on Wheat from Buffalo to New York, and the Elevating and Storage Rates at Buffalo from 1870 to 1901.

(Prepared by the Secretary of the Buffalo Merchants' Exchange.)

Year.	Average canal freight rates. Cents.	Tolls.* Cents.	Elevating, including storage.† Cents.
1870,	11.2	3.1	1.25
1871,	12.6	3.1	1.25
1872,	13	3.1	1.25
1873,	11.4	3.1	1.25
1874,	10	3.1	1.25
1875,	7.9	2	1
1876,	6.6	2	1
1877,	7.4	1	1
1878,	6	1	1
1879,	6.8	1	1
1880,	6.5	1	1
1881,	4.7	1	.875
1882,	5.4	1	.875
1883,	4.9	....	.875
1884,	4.2	....	.875
1885,	3.8	....	.875
1886,	5	....	.875
1887,	4.5	....	.875
1888,	3.4	....	.875
1889,	4.8	....	.875
1890,	3.8	....	.875
1891,	3.5	....	.875
1892,	3.5	....	.875
1893,	4.6	....	.875
1894,	3.2	....	.875
1895,	2.2	....	.875
1896,	3.7	....	.875
1897,	2.8	....	.875
1898,	2.8	....	.500
1899,	3	....	.500
1900,	2.5	....	.500
1901	3.5	....	.500

*Tolls abolished after 1882.

†Storage varied; 5 to 10 days the limit.

TABLE III.

Average Freight Rates on Grains, Flour and Provisions (per 100 pounds), Through from Chicago to European Ports, by all Rail to Seaboard and thence by Steamers, from 1892 to 1901.

(Prepared by Secretary of the Board of Trade, Chicago.)

Shipped to—Articles.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Liverpool:										
Grain,	$0.3287	$0.3110	$0.3250	$0.3200	$0.3350	$0.3360	$0.3435	$0.2972	$0.2948	$0.2147
Sacked flour,	.3625	.3513	.3316	.3400	.3430	.3681	.3760	.3012	.2790	.2300
Provisions,	.4575	.4547	.4466	.4181	.4191	.4440	.4715	.4050	.4884	.3600
Glasgow:										
Grain,	.3550	.3585	.3463	.3410	.3122	.3523	.3600	.3325	.3098	.2410
Sacked flour,	.3306	.3625	.3503	.3625	.3650	.3906	.3906	.3125	.3156	.3438
Provisions,	.4969	.4828	.4659	.4969	.4997	.5250	.5250	.4469	.5531	.4510
London:										
Grain,	.3462	.3760	.3288	.3329	.3348	.3400	.3570	.3060	.3110	.2323
Sacked flour,	.3681	[illegible]	.3493	.3513	.3528	.3612	.3725	.3350	.3501	.3150
Provisions,	.4688	.4828	.4575	.4603	.4715	.4814	.4969	.4414	.5587	.4475
Antwerp:										
Provisions,	.5025	.4828	.4688	.4828	.4969	.5109	.5250	.4750	.5109	.4625
Hamburg:										
Provisions,	.5000	.5250	.5000	.5000	.5100	.5100	.5200	.4600	.5000	.4400
Amsterdam:										
Provisions,	.5500	.5000	.5000	.5000	.5200	.5200	.5250	.4700	.5100	.4500
Rotterdam:										
Provisions,	.5500	.5000	.5000	.4800	.5200	.5200	.5250	.4700	.5100	.4500
Copenhagen:										
Provisions,	.6094	.5531	.5531	.5531	.5812	.5728	.5813	.5172	.5531	.4775
Stockholm:										
Provisions,	.7219	.6656	.6656	.6656	.6937	.6853	.6925	.6297	.6450	.5325
Stettin:										
Provisions,	.6094	.5531	.5531	.5531	.5812	.5728	.5813	.5172	.5531	.4775
Bordeaux:										
Provisions,	.6200	.6000	.6250	.6413	.6413	.6413	.6575	.5912	.6412	.5425

TABLE IV.

Average Freight Rates on Grain and Flour from St. Louis to Various Points from 1878 to 1901.

(Prepared by George H. Morgan, Secretary Merchants' Exchange, St. Louis.)

Calendar Year.	To New Orleans by River. On grain in sacks per 100 pounds. Cents.	To New Orleans by River. On wheat in bulk by barges per bushel. Cents.	To New York by Rail. On wheat per 100 pounds. Cents.	To New York by Rail. On flour per barrel. Cents.	To Liverpool. Via New Orleans on wheat per bushel. Cents.	To Liverpool. Via New York on wheat per bushel. Cents.
1878,	17.5	7.25	38	76	....	....
1879,	18	7.75	33.5	67	....	....
1880,	19	8.25	42	84	....	....
1881,	20	6	32	64	....	....
1882,	20	6.42	29.5	59	22.66	23.66
1883,	97.75	5.5	33	66	19.58	27
1884,	14	6.63	26	52	14.58	21.25
1885,	15	6.4	22.14	44.29	15.11	20.5
1886,	16	6.5	29	58	16.17	24
1887,	18	6.5	32.13	64.25	14.8	24.8
1888,	15	6.5	29.5	59	15.17	22.95
1889,	17.93	5.95	28.5	58	17.33	24.97
1890,	15.56	6.58	27.63	52.63	14.33	21.48
1891	16.28	6.88	29	58	15.75	23.55
1892,	16.87	6.50	26.62	58	14	21
1893,	17.54	6.55	28.5	57	14.71	21.72
1894,	17.14	5.89	24.73	50	11.69	18.71
1895.*	13	5.95	23.57	47	12.13	18.33
1896,	14.54	5	23	46	13.50	19.67½
1897,	10.83	4.88	23.64	47.26	12.89	20.33
1898,	10	4.50	22.25	45.10	14.24	20.32
1899,	10	4.50	21.95	43.90	12.33	17.88
1900,	10	†4.25	19.38	38.76	14.64	18.41
1901,	10	†4.25	19.38	38.66	9.48	14.03

*The figures represent published rates since 1894.
†F. o. b. New Orleans.

LIST OF NURSERIES IN PENNSYLVANIA WHICH WERE GRANTED CERTIFICATES IN 1901.

Adams County.

		Acres.
Adams, W. S.,	Bendersville,	7
Bender, Cornelius,	Bendersville,	[illegible]
Bream, H. L.,	Cashtown,	2
Cline, Harry,	Idaville,	[illegible]
Cook, E. W.,	Aspers,	3
Elden, R. E.,	Aspers,	5
Garretson, Eli P.,	Biglerville,	2
Garretson, Robert,	Bendersville,	[illegible]
Grove, W. E.,	York Springs,	12
Golden, H. J.,	Bendersville,	[illegible]
Hare, J. M.,	Fairfield,	3
Heiner, H. M.,	Gettysburg,	¼
House; O. P.,	Bendersville,	6
Longsdorf, C. L.,	Floradale,	19
Myers, William,	Bendersville,	½
Osborn, C. L.,	Floradale,	½
Peters, A. H.,	Biglerville,	1
Peters, John H.,	Bendersville,	3
Porter, C. E.,	Bendersville,	3
Rice and Trostle,	Arandtsville,	1
Sheely, Mrs. Angeline,	Bendersville,	2
Sowers, H. W.,	Latimore,	1½
Stoner, C. A.,	Gettysburg,	2
Storrick & Hartman,	Gettysburg,	1
Stover, John P.,	Cashtown,	2
Taylor, A. D.,	Arendtsville,	2
Tyson, C. J.,	Floradale,	3
Weaver, Dr. G. P.,	New Oxford,	2
Wilson, B. F.,	Floradale,	1½
Wilson, Charles J.,	Mummasburg,	4
Wilson, C. S.,	Floradale,	¼
Wright, A. S.,	Bendersville,	6
Wright, G. E.,	Floradale,	½
	33 Nurseries.	99½

Allegheny County.

[illegible]	Springdale,	12
Murdock, J. B., & Co.,	No. 510 Smithfield St., Pittsburg,	8
	2 Nurseries.	20

Beaver County.

Mitchell, R. C., & Bros.,	Beaver,	8

Bedford County.

Bernhart, Joel,	Bedford,	3
Wright, Austin,	Alum Bank,	4
	2 Nurseries.	7

Berks County.

Oberlin, T. J.,	Sinking Spring,	2
Smeltzer, M. E.,	Wernersville,	½
Stoudt, William,	Centreport,	¾
	3 Nurseries.	3¼

Blair County.

		Acres
Blair County Nursery Co.,	East Freedom,	8
Kemp, H. B.,	East Freedom,	4
	2 Nurseries,	12

Bucks County.

Janney, Horace,	Newtown,	7
Landreth, D., & Sons,	Bristol,	15
Moon, Samuel C.,	Morrisville,	40
Moon, The William H. Co.,	Morrisville,	150
Palmer, Henry,	Langhorne,	4
	5 Nurseries,	216

Butler County.

Pierce Bros.,	Butler,	20

Chester County.

Achelis, George,	West Chester,	175
Conard & Jones, The, Co.,	Westgrove,	¼
Hoopes, Bro. & Thomas,	West Chester,	600
Keech, J. F.,	Oxford,	¼
Rakestraw & Pyle,	Willowdale,	95
Roberts, Josiah A.,	Malvern,	20
	6 Nurseries,	890½

Crawford County.

Prudential Orchard Co.,	Shermansville,	8

Cumberland County.

Peters, John, & Co.,	Uriah,	50
Rupp, D. C.,	Shiremanstown,	1
Woodview Nurseries,	Uriah,	50
	3 Nurseries,	101

Dauphin County.

Rife & Ulrich Nursery Co.,	Royalton,	3
Scholl, Calvin P.,	Fisherville,	31
	2 Nurseries,	34

Delaware County.

Gardner, John G.,	Villa Nova,	7
[illegible], M. F.,	[illegible]	1
[illegible]	Lansdowne,	2
Oak Nursery Co., P. Z. Supplee, Manager,	Collingdale,	1[illegible]
[illegible]	Lansdowne,	2
[illegible], J. J.,	[illegible]	[illegible]
[illegible]	[illegible]	5
	7 Nurseries,	32

Erie County.

Archibald, C. E.,	Girard,	1
[illegible]	North East,	4
	2 Nurseries,	5

Fayette County.

		Acres.
Sterling, J., & Son,	Masontown,	2[illegible]

Franklin County.

Byer Bros.,	Chambersburg,	[illegible]
Fisher, Philip,	Chambersburg,	¼
Heffelfinger,	Greenvillage,	4
Good, A. M.,	Waynesboro,	1
Reed, William B.,	Chambersburg,	1
	5 Nurseries,	6

Huntingdon County.

Snyder, J. Peter,	Huntingdon,	½

Juniata County.

Landis & Wagner,	McCulloch's Mills,	1[illegible]

Lackawanna County.

Hull, E. J.,	Olyphant,	2

Lancaster County.

Bolton, W. P.,	Liberty Square,	4
Brinton, William P.,	Christiana,	19
Cooper, Calvin,	Bird-in-Hand,	3
Engle, H. M., & Son,	Marietta,	2
Engle Bros.,	Marietta,	10
Harnish, H. H.,	Huber,	8
Herr, Daniel D.,	Lancaster,	8
Hess, S. R., & Son,	Ephrata,	4
Kready, John, & Son,	Mt. Joy,	2
Laushey, O. W.,	Bird-in-Hand,	2
Root, A. W., & Bro.,	East Petersburg,	14
	11 Nurseries,	76

Lawrence County.

Butz, W. T. & F. P.,	New Castle,	1
Fisher, D. W., & Son,	New Wilmington,	1½
Hayes, J. W.,	Bessemer,	4
Moore, A. S.,	New Castle,	1
	4 Nurseries,	7½

Lycoming County.

Evenden Bros.,	Williamsport,	1

Mercer County.

Hoobler, J. L.,	Chess,	3
Nelson, J. W.,	Indian Run,	3
Unger, Charles L.,	Chess,	1
	4 Nurseries,	7

Montgomery County.

Brehm, Rudolph,	Hatfield,	½
Haines, Robert B., & Co.,	Cheltenham,	10
Heckler, J. B.,	Lansdale,	4
Krewson, James, & Son,	Cheltenham,	8
Meehan Bros.,	Dreshertown,	115
Moore, Jacob B.,	Hatfield,	5
North Wales Nursery Co., G. M. Buttery, Mgr.,	North Wales,	40
Rieg, John,	Jenkintown,	10
Sturzebecker, William,	Lansdale,	½
Wilson, Charles H.,	Gladwyne,	3
	10 Nurseries.	196

Northampton County.

Roth, Theodore,	Nazareth,	2

Perry County.

Wagner, George A., & Co.,	Alinda,	35

Philadelphia County.

Harper, William Warner,	Chestnut Hill,	250
Meehan, Thomas, & Sons,	Germantown,	65
Stephenson's, John, Sons,	Oak Lane,	3
Yates, Thaddeus N., & Co.,	Germantown,	½
	4 Nurseries.	318½

Somerset County.

Pfeiffer, H. C., & Bro.,	Glades,	3
Village Nurseries, G. W. Kemp, Proprietor,	Harnedsville,	18
	2 Nurseries.	21

Venango County.

Sutton, H. S., Son,	Franklin,	6

Westmoreland County.

McAdams, John,	Mount Pleasant,	10

York County.

Glen Rock Nurseries, W. S. Newcomer, Prop.,	Glenrock,	3
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SPRAYING CALENDAR.

A Brief Outline of the Best Methods for the Protection of Crops From Insects and Fungi.

The utility of some condensed outline showing how and when to spray or otherwise treat fruit trees, shade trees, garden and field crops, and flowers, to prevent or check injuries by insects and plant diseases, is demonstrated by the number of such publications in other States. It is practicably impossible, however, to include in such a paper, all of the foes of the agriculturist, and accordingly, only such are considered as have been found to be most likely to be present in Pennsylvania. At the same time, treatment for the injuries touched on here, will, in nearly every case, also control those not treated of, and accordingly, in this way the ground will be nearly as well covered as though all such foes were considered in detail.

In all cases, treatment according to the directions here given must be applied with judgment, as no fixed rules can be given which will hold for every case, and an ignorant adherence to the directions without a knowledge of the particular conditions of the case, may fail to give the desired results. To obtain success in the control of insect and fungous foes, a knowledge of what the foe is, the best way to attack it, and when this attack is most effective, are necessary.

Any information desired on these subjects may be obtained by writing to the Division of Zoology, Department of Agriculture, Harrisburg, Pa., and the sending of samples of injury done, or of the insects or other foes causing the trouble will greatly aid in giving satisfactory answers.

Apple.

CODLING MOTH:

1. Paris green or Arsenate of Lead as soon as blossoms have fallen. 2. Repeat about ten days later. 3. Repeat in severe cases two weeks later. 4. Repeat about August 1 for second brood. See Report of Department for 1898.

BUD-MOTH:

1. Paris green or Arsenate of Lead as soon as leaf buds become green. 2. Repeat 1 just before blossoms open. 3. Repeat 2 after blossoms fall.

CANKER-WORM:

1. Paris green or Arsenate of Lead when caterpillars appear. 2. Same ten days later. 3. Repeat every ten days if needed.

TENT CATERPILLAR:

1. Destroy tents at night by torch. 2. If any escape, treatment for Codling moth will destroy them. See Report of Department for 1898.

PLUM CURCULIO:

1. Treatments 1 and 2 as for Bud moth. See also under "Plum."

BORERS:

1. Cut out those already in the tree, in May. 2. Wrap several thicknesses of paper around the trunk and fasten, about the first of June, and leave till September; cover upper part of trunk and larger limbs with whitewash and a little Paris green, at the same time. See Report of Department for 1898.

OYSTER-SHELL SCALE AND SCURFY SCALE:

1. If severe, scrape the parts affected or spray with Whale Oil Soap before buds swell in spring. 2. Spray about the 5th of June, with Kerosene Emulsion. 3. Repeat 2 about June 25th. See Bulletin 43 of Department.

SAN JOSE SCALE:

See under "Peach."

SCAB:

1. Spray with Bordeaux mixture and Paris green just before the blossoms open. 2. Repeat 1 as soon as blossoms have fallen. 3. Repeat 1 about ten days later, and 4, if necessary two weeks later.

BITTER-ROT:

Same treatment as for Scab.

APPLE LEAF RUST:

1. Destroy all Red Cedar trees in the neighborhood of the orchard as this fungus passes a part of its life on the Cedars, causing the "Cedar Apples."

Apricot.

See Peach.

Asparagus.

ASPARAGUS BEETLES:

1. Destroy all volunteer asparagus, leaving only the shoots designed for market. 2. Let fowls run among the plants. 3. If serious, dust with fresh-dry-slacked lime while dew is on. 4. Repeat 3 every other day of ten days.

Bean.

ANTHRACNOSE OR POD SPOT:

1. Spray with Bordeaux mixture when first true leave has formed. 2. Repeat 1 often enough to keep leaves covered by the mixture till a week before eating pods. 3. Soaking the seed before planting, in ammoniated copper carbonate for an hour is a very effectual treatment.

LIMA BEAN MILDEW:

1. Burn all parts of the plant at once after harvesting the crop.

Beet.

RUST:

1. Spray with Bordeaux mixture as soon as it appears. 2. Remove and burn all affected leaves.

LEAF SPOT:

1. Use Bordeaux mixture when four leaves have appeared 2 Repeat at intervals to keep the mixture on the leaves 3. Burn the leaves as soon as the crop has been gathered.

Cabbage and Cauliflower.

APHIS:

1. Use Kerosene Emulsion when they appear. 2. Repeat when needed till plants begin to head. 3. After heading begins use hot water or tobacco water.

CABBAGE WORM:

1. Paris green or Arsenate of Lead when the caterpillars first appear. 2. Repeat about every ten days till heading begins. 3. After heading begins, use Kerosene Emulsion or hot water as often as may be needed. 4. Fresh lime applied while dew is still on is also a good method.

ZEBRA CATERPILLAR:

1. Destroy the caterpillars as soon as they appear, while they are yet in company. 2. Use Paris green when needed, till the head begins to form, or the "flower" appears in the case of cauliflower. 3. Hand picking or hot water when poisons cannot be safely used. See Report of the Department for 1898.

ROOT MAGGOT:

1. When the maggots are first noticed, make a small hole near the main root of the plant, pour in half a teaspoonful of Carbon Disulphide, and close up the hole. 2. Tarred paper cut to let the plant grow up through the centre but fitting closely to the stem and onto the ground is a good preventative method. See Report of Department for 1898.

HARLEQUIN CABBAGE BUG:

A recent addition to cabbage foes in Pennsylvania. A hard black bug with red or orange markings, nearly half an inch long when full grown. 1. Plant a trap crop of mustard early for the bugs to collect on and gather them from this or spray it with pure kerosene. 2. Gather the bugs and egg masses by hand. See Report of Department for 1898.

CLUB-ROOT:

1. Burn affected plants. 2. Strict rotation of crops. 3. Lime, 75 bushels to the acre, has been highly recommended as a preventative.

Carnation.

ANTHRACNOSE AND RUST:

1. Bordeaux mixture on first appearance. 2. Repeat every two weeks till flowers appear. 3. After flowers appear, use ammoniacal copper carbonate every two weeks.

Celery.

CELERY CATERPILLAR:

1. Paris green while plants are small. 2. Later, hand picking if necessary.

BLIGHT OR RUST:

1. Ammoniacal copper carbonate. 2. Repeat once a week. 3. Artificial shade is advantageous.

LEAF-BLIGHT:

Same as for Rust.

SOFT-ROT:

Chiefly in plants stored or banked in wet places. 1. Keep dry, Or 2. Place under pure water.

Cherry.

APHIS:

1. Kerosene Emulsion when they first appear. 2. Repeat every three or four days, if necessary.

SLUG:

1. Paris green or Arsenate of Lead. 2. Repeat if needed every ten or twelve days.

CURCULIO:

See under "Plum."

BLACK KNOT:

1. Cut off the branches six inches or more below the injured place and burn them. 2. Get your neighbors to do the same to their trees. United action is necessary if the disease is to be stamped out.

ROT:

1. Bordeaux mixture before blossoms open. The addition of Paris green at this time is a good plan. 2. Repeat, without Paris green, when the fruit has set. 3. Repeat 2 twice at intervals of one to two weeks.

LEAF BLIGHT:

Same as for Rot.

Chrysanthemum.

LEAF-SPOT:

1. Bordeaux mixture on first appearance. 2. Repeat every two weeks if needed.

Corn.

WIRE-WORMS:

1. Rotation of crops. 2. Late fall plowing, repeated for several years. 3. Kainit, 1,000 pounds per acre has been highly recommended. See Report of Department for 1898.

CUT-WORMS:

1. Trap by scattering bunches of fresh clover, dipped in Paris green over the field before planting. 2. Place such bunches along the rows, later. Caution: Keep fowls and stock away.

CORN WORM OR BOLL WORM:

1. Hand picking. 2. Late fall plowing. See Report of Department for 1898.

SMUT:

1. Cut out and burn all portions affected, as soon as discovered.

Cucumber and Squash.

STRIPED CUCUMBER BEETLE:

1. Netting till plants are well established or, 2. Powdered refuse tobacco around the stems, occasionally renewed. See Report of Department for 1898.

SQUASH BUG:

1. Burn vines immediately after gathering the crop. 2. Hand picking.

MILDEW:

1. Bordeaux mixture on first appearance. 2. Burn vines after gathering the crop.

Currant and Gooseberry.

CURRANT WORM:

1. Paris green or Hellebore when the worms first appear. 2. Repeat, using Hellebore every ten days or two weeks if needed.

STEM GIRDLER:

1. Cut off stem three inches below the girdled place and burn.

GOOSEBERRY FRUIT WORM:

1. Let fowls run among the plants. 2. Pick off and destroy injured fruit. 3. Rake up and burn the fallen leaves and rubbish near by, in the fall.

FOUR-LINED LEAF BUG:

1. Spray with Kerosene Emulsion one part; water five parts, in May.

LEAF-SPOT:

1. Spray with ammoniacal copper carbonate soon after leaves open. 2. Repeat with Bordeaux mixture every two weeks as long as needed. 3. Gather and burn fallen leaves in the fall.

MILDEW:

1. Spray with Potassium Sulphide solution (liver of sulphur) as the leaves begin to open. 2. Repeat every two or three weeks if needed.

Egg Plant.

LEAF-SPOT:

1. Bordeaux mixture as soon as plants are established in the field. 2. Repeat every two or three weeks till fruit is half grown. 3. Then use ammoniated carbonate.

Elm.

ELM LEAF BEETLE:

1. Spray with Paris green or Arsenate of Lead when leaves first open. 2. Repeat two weeks later. 3. Repeat if necessary.

TUSSOCK MOTH:

1. Gather and destroy the whitish egg masses in winter. 2. Repeat in July or August, before the eggs hatch and the caterpillars scatter. 3. If the caterpillars are feeding, spray with Paris green or Arsenate of Lead as often as needed.

Grape.

ROSE BUG:

1. Collect the insects by hand. 2. Bag the forming bunches of grapes. See Report of Department for 1898.

GRAPE VINE FLEE BEETLE:

1. Spray with Paris green or Arsenate of Lead as soon as seen. 2. Repeat every week if necessary.

GRAPE-VINE LEAF HOPPER:

1. Dust the vines with insect powder or tobacco dust about the first of July. 2. Repeat one week later if necessary.

ANTRACNOSE:

1. Brush the vines over with Sulphate of Iron and Sulphuric Acid solution before the buds open. 2. Repeat three or four days later. Do not use after the vines start growing.

DOWNY MILDEW, POWDERLY MILDEW:

1. Bordeaux mixture when leaves are fully opened. 2. Repeat about ten days before the flowers open. 3. Spray with potassium sulphide solution three weeks later if necessary.

BLACK ROT:

1. Bordeaux mixture as the buds open. 2. Repeat every two weeks if needed, till fruit is half grown; then use ammoniacal copper carbonate, repeating every week or two if necessary.

RIPE ROT:

1. Same treatment as 2 under black rot.

Hollyhock.

RUST:

1. Bordeaux mixture as leaves open. 2. Repeat at intervals of ten days if needed.

Maples.

TUSSOCK MOTH:

See under "Elm."

COTTONY MAPLE SCALE:

1. Spray with Kerosene Emulsion early in June. 2. Repeat in two weeks if necessary.

Nursery Stock.

SUCKING INSECTS:

1. Kerosene Emulsion as soon as discovered. 2. Repeat in two weeks if necessary.

CHEWING INSECTS:

1. Paris green or Arsenate of Lead when discovered. 2. Repeat as may be needed.

FUNGOUS DISEASES:

1. Bordeaux mixture when leaves open. 2. Repeat every two weeks if needed.

Oats.

LOOSE SMUT:

Soak the seed five to ten minutes in hot water at 133 degrees F. This may be done some time before planting, if desired, and hasten sprouting besides destroying the Smut.

RUST:

No good treatment known.

MAGGOT:

1. Put the onion bed some distance from the one of the preceding year. 2. Same treatment as for the cabbage root maggot.

MILDEW:

1. Burn all the tops in the fall. 2. Rotation of crops.

SMUT:

1. Burn all refuse in the fall. 2. Start the onions on land not used for onions the preceding year and transplant—a process which pays for other reasons also.

Peach, Apricot, Nectarine.

PEACH BORER:

1. Wrapping trunk as described for Apple Tree Borer. 2. Mounding up earth a foot or more about June 1st, and removing about September 1st. 3. Wash trunk and lower parts of limbs with whitewash and a little glue, with a tablespoonful of Paris green to each bucketful. One, 2 and 3 are alternate methods treatment. See Report of Department for 1898.

BLACK PEACH APHIS:

1. Dig refuse tobacco powder or stems, or Kainit into the ground about the roots. 2. Spray with Kerosene Emulsion when the Aphis appears above the ground.

CURCULIO:

See under "Plum."

SAN JOSE SCALE:

1. Keep trunk and limbs covered with whitewash from June 1st, till frost appears. 2. Spray with Whale Oil Soap, 1 lb. to 1 gal-

lon of water, after the leaves are off in the fall. 3. Spray with Whale Oil Soap, 2lbs. to I gallon of water, before the buds start in the spring. 4. Cut back and thoroughly prune infested trees after spraying and burn the prunings. 5. Destroy badly infested plants. See Bulletin No. 43 of Department.

PEACH LEAF CURL:

1. Spray with Copper Sulphate before buds open in spring. 2. Spray with Bordeaux mixture when leaves are half grown.

PEACH ROSETTE:

No good remedy.

BROWN ROT:

1. Spray with Copper Sulphate before buds open. 2. Bordeaux mixture before flowers open. 3. Repeat 2 every ten to fourteen days after fruit has set, until the fruit is half grown. 4. Repeat every five to seven days, using ammoniacal copper carbonate instead of Bordeaux mixture.

YELLOWS:

1. Destroy all affected trees by fire. 2. Dig out and burn roots also.

Pear.

BORERS:

See under apple.

CODLING MOTH:

See under apple.

PEAR MIDGE:

1. Apply 1,000 lbs. of Kainit per acre, to the ground beneath the trees about the middle of June.

PEAR LEAF MITE:

1. Spray in winter with Kerosene Emulsion, 1 part; water 6 parts.

PEAR PSYLLA:

1. Spray with Whale Oil Soap, 1 lb. to 1 gallon of water, in April, spraying only the trunk and larger branches.

SLUG:

See under Cherry.

SAN JOSE SCALE:

See under Peach.

LEAF BLIGHT OR FRUIT-SPOT:

1. Spray with ammoniacal copper carbonate as the leaves open. 2.Bordeaux mixture just before the blossoms open. 3. Repeat 2 after fruit has set, at intervals of two weeks as needed.

FIRE BLIGHT:

Cut off and burn affected parts, cutting at least a foot below where the disease shows.

SCAB:

See under Apple.

Plum.

CURCULIO:

1. Spray with Paris green or Arsenate of Lead before the flower buds open. 2. Repeat 1 soon after the blossoms have fallen. 3. Gather the insects by jarring onto cloths beneath the tree, at night and in the morning. 4. Gather and destroy fallen plums every day. 5. Let fowls run under the trees.

PLUM LECANIUM:

1. Kerosene emulsion one part, water four parts, after leaves have fallen in the fall. 2. Repeat 1 in spring before the buds open.

SLUG:

See under Cherry.

BORERS:

See under Apple.

SAN JOSE SCALE:

See under Peach.

LEAF BLIGHT:

1. Bordeaux mixture when the leaves first appear. 2. Repeat 1 after the fruit has set, every two or three weeks till fruit is three-quarters grown. 3. Now use ammoniacal copper carbonate if needed, every two or three weeks.

BROWN ROT:

See under Peach.

BLACK KNOT:

See under Cherry.

Potato.

POTATO BEETLE:

1. Paris green or Arsenate of Lead as soon as insects are seen. 2.Repeat whenever needed.

POTATO STALK BORER:

1. Gather and burn all stalks after gathering the crop.

EARLY BLIGHT OR LEAF SPOT:

1. Bordeaux mixture when plants are half grown. 2. Repeat 1 every two or three weeks.

POTATO ROT:

1. Bordeaux mixture about the middle of July. 2. Repeat 1 every two weeks.

SCAB:

Soak seed potatoes in corrosive sublimate 1 ounce, water 8 gallons, for one and one-half hours before cutting them.

LATE BLIGHT OR MILDEW:

1. Bordeaux mixture when the disease appears. 2. Repeat 1 whenever needed.

Quince.

CURCULIO:

1. Jarring as for Plum Curculio.

LEAF BLIGHT:

1. Bordeaux mixture before flower buds open. 2. Repeat 1 when fruit has set, and every two or three weeks until fruit is three-quarters grown. 3. Ammoniacal copper carbonate later, if needed.

FIRE BLIGHT:

See under Pear.

Raspberry, Blackberry, Dewberry.

SLUG:

1. Paris green or Arsenate of Lead when insects first appear. 2. Repeat 1 two weeks later unless fruit is nearly ripe.

SNOWY TREE-CRICKET:

Cut off and burn twigs pierced, during the winter, to destroy the eggs in them.

ANTHRACNOSE:

1. Cut out all badly diseased canes. 2. Copper Sulphate solution before the buds open. 3. Bordeaux mixture after growth has commenced. 4. Repeat 3 every two or three weeks till fruit is two-thirds ripe.

ORANGE RUST:

1. Cut out and burn all diseased plants. 2. Get your neighbors to do the same.

Rose.

APHIS AND LEAF HOPPERS:

1. Kerosene Emulsion, strong soap suds or tobacco water as often as needed.

SLUGS:

Dust with quick lime.

RED SPIDER.

Syringe with clear water. If very abundant, Kerosene Emulsion.

BLACK SPOT:

Spray once a week with ammoniacal copper carbonate.

MILDEW:

1. Spray with Bordeaux mixture or ammoniacal copper carbonate as often as necessary. 2. In greenhouses, fumigation with sulphur.

RUST:

1. Destroy all affected portions. 2. Gather and burn dead leaves in the fall. 3. Ammoniacal copper carbonate after leaves open.

Strawberry.

SLUG:

See under Raspberry.

WEEVIL:

No good remedy.

LEAF BLIGHT:

1. Bordeaux mixture after the crop is gathered. 2. Repeat 1 when leaves open in the spring. 3. Repeat 2 just before blossoms open.

Tomato.

TOMATO WORM:

1. Hand picking. 2. Paris green or Arsenate of Lead, as needed, till fruit begins to turn in color.

CORN WORM:

See under Corn.

FLEA BEETLE:

Paris green or Arsenate of Lead as often as needed.

LEAF BLIGHT:

1. Bordeaux mixture as soon as disease is discovered. 2. Repeat 1 every week or ten days.

ROT:

Same treatment as for Leaf Blight.

Violet.

RED SPIDER:

See under Rose.

BLIGHT SPOT:

Bordeaux mixture when disease appears. Repeat every ten days when blossoms are not present. 3. Remove affected leaves.

Wheat.

HESSIAN FLY:

1. Plant a trap piece about August 1st. 2. Plow under about September 10th, and plant main crop after September 20th. See Report of Department for 1898.

WHEAT MIDGE:

1. Plow deep soon after harvest. 2. Carefully sweep up and burn chaff and "tailings" after threshing. See Report of Department for 1898.

APHIS:

No good treatment. See Report of Department for 1898.

FORMULAS.

PARIS GREEN.

	Parts.	Per bbl.
Paris green,	1 lb.	$\frac{1}{4}$ lb.
Quick lime,	1 lb.	$\frac{1}{4}$ lb.
Water,	200 gals.	50 gals.

This is too strong for the peach, where $2\frac{1}{2}$ oz. each of Paris green and quick lime should be used instead of $\frac{1}{4}$ lb. Keep the mixture well stirred while using. To make it, mix the Paris green and the lime and add enough of the water to slake the lime, stirring while hot, then add the rest of the water.

Good Paris green gives far better results than the cheaper grades.

ARSENATE OF LEAD.

This is a comparatively new insecticide, its value having only become known within a few years. It has several advantages over either Paris green or London purple, the chief ones being that it remains more easily suspended in water, thus requiring much less stirring up during the spraying; that it shows plainly on the leaves, indicating where the spray has reached, and where it has not; and that large proportions may be used without danger of burning the leaves. It is therefore especially useful where the leaves are particularly sensitive.

	Parts.	Per bbl.
Arsenate of soda,	4 oz.	2 oz.
Acteate of lead,	11 oz.	$5\frac{1}{2}$ oz.
Water,	100 gals.	50 gals.

These two substances, when placed in the water dissolve rapidly, and combine, forming a fine white sediment which is the Arsenate of Lead. It can also be purchased ready for addition to the water, but it is usually better when prepared as above. It is as cheap, or in the end cheaper than Paris green, as it stays much longer on the trees before being washed off by the rains. Some persons advise the addition of two quarts of molasses to each hundred gallons of the water, but the benefit to be derived from this is questionable.

WHALE OIL SOAP.

	Parts.	Per bbl.
Whale oil soap, ...	2 lbs.	80 lbs.
Water, ...	1 gal.	40 gals.

This is much stronger than Kerosene Emulsion and should only be used during winter, when the trees are not growing. It can be used for insects which cannot be killed by Kerosene Emulsion. In spraying for the San José Scale in the fall (see under Peach), it should be used at the rate of one pound to a gallon of water; in the spring before the buds open, or for winter work, it can be used as above given.

KEROSENE EMULSION.

	Parts.	Per bbl.
Hard soap (shaved fine), ...	½ lb.	1 lb.
Water, ...	1 gal.	2 gals.
Kerosene, ...	2 gals.	3½ gals.

Dissolve the soap in the water, which should be boiling, and while it is very hot pour the suds into the kerosene; then churn it with a spray pump till it changes to a creamy mass, and then to a soft, butter-like substance. This should keep for some time. When it is desired to use it, add one part of it to nine times as much water, mix well, and spray the plants. The water should be soft water, or else have some soda added to it.

For the Four-lined Leaf bug take one part of the Emulsion and five parts of water.

TOBACCO WATER.

Place tobacco stems or refuse tobacco in enough hot water to cover; let stand several hours. Take one part of this to three or four of water, and spray over the plants.

CARBON DISULPHIDE.

To be obtained of druggists at about thirty cents per pound. In using, avoid bringing it near fire or even hot steam pipes as it catches fire easily. Avoid breathing it also.

HELLEBORE.

May be applied either as a powder or in water. If used as a powder it may advantageously be mixed with an equal amount of flour, which causes it to remain better on the leaves. For use with water one ounce of fresh Hellebore is mixed with three gallons of water.

INSECT POWDER.

Insect powder is sometimes sold under the names of Pyrethrum and Buhach. It may be applied as the dry powder, when the plant is wet with dew. It may also be mixed with flour and used in that way, or it may be used in an alcoholic solution as follows:

Insect powder (by weight), ...	1 part.
Alcohol (by weight), ...	4 parts.

Put the two in a tight vessel and leave there for eight days, shaking occasionally; then filter and spray over the plants.

It should be remarked that Insect Powder is only of value when fresh and of full strength. Unfortunately it is difficult to obtain it fresh, and much of it is so adulterated as to be practically worthless.

LIME.

Lime is often of much value as an insecticide, either as whitewash, sometimes with enough Paris green added, to give it a slight greenish tinge, or as quick lime to be dusted onto the insects. When used in the preparation of Paris green it is added to combine with the free arsenic present, which would burn the leaves, if left uncombined.

NORMAL OR 1.6 PER CENT. BORDEAUX MIXTURE.

Copper sulphate (blue vitriol), ...	6 pounds.
Quick lime (good stone lime), ...	4 pounds.
Water, ...	50 gallons.

Dissolve the copper sulphate by putting it in a bag of coarse cloth and hanging this in a vessel containing 4 to 6 gallons of water. Use an earthen or wooden vessel. After the copper sulphate is dissolved, dilute with water to 25 gallons. Slake the lime and add 25 gallons of water. Mix the two and keep thoroughly stirred while using. If the mixture is to be used on peach foliage, it is advisable to add two pounds more of lime to the above formula.

BORDEAUX MIXTURE AND PARIS GREEN.

Mix 4 ounces of Paris green as prepared above, with 50 gallons of normal Bordeaux mixture.

AMMONIACAL COPPER CARBONATE.

Copper carbonate,	4 ounces.
Ammonia,	3 pints.
Water,	45 gallons.

Make a paste of the copper carbonate with a little of the water. Dilute the ammonia with 7 or 8 times its bulk of water. Add the paste to the diluted ammonia and stir until dissolved. Add enough water to make up to the 45 gallons. Let it settle and use the clear blue liquid only. Do not make this up long before using as it loses its strength on standing. It is used when the fruit is so nearly ripe that Bordeaux mixture would produce stains if it were used.

POTASSIUM SULPHIDE SOLUTION.

(Liver of Sulphur.)

Potassium sulphide,	½ to 1 ounce.
Water,	1 gallon.

Particularly good for surface mildews but loses its strength upon standing, so should be used at once after making.

SULPHATE OF IRON AND SULPHURIC ACID SOLUTION.

Water (hot),	100 parts.
Iron sulphate (green vitriol),	as much as the water will dissolve.
Sulphuric acid (commercial),	1 part.

Make the mixture with much care, as heat is produced. Use on plants when dormant only, applying with brushes or sponges, as the solution is injurious to spraying machinery.

CORROSIVE SUBLIMATE.

This dissolves slowly and but slightly in water. The process may be hastened by heating the water.

GENERAL REMARKS.

In the treatment of fruits by sprays it should be remembered that the substances used are in almost every case poisonous. It is accordingly necessary to avoid spraying at times when fruit is nearly ripe, both on account of the possibility of placing poison on the fruit just before it is picked, and because of the danger of staining it, as would be the case if certain solutions were used.

Spraying solutions often need to be carefully strained, and it is advisable to do this when putting them into the barrel or other receptacle from which they will pass through the spray pump. Nozzles will clog from larger lumps in the fluid, and care should be taken to avoid this as far as possible. Every pump should have an agitator

attached to keep the mixture well stirred in the barrel, and it should not be expected that the same nozzle will do first class work with every spraying mixture given. Some nozzles are especially adapted to one kind of spray, and others to other sprays. Above all, an intelligent knowledge of what is causing the injury, and exactly how and when to take the proper steps to control it, should be one of the ingredients added to every formula here given.

ROAD STATISTICS.

TABLE I.

Force Required to Draw a Load on Different Kinds of Roads. (Gilmore.)

	Force required to draw a gross load of 2,240 pounds.	Steepest grade (rise per 100 feet) on which vehicle will not roll back.	Draught on a Level Compared with that on Difficult Grades. Rise in Feet per 100 Feet.					
			Nought.	Three.	Six.	Nine.	Twelve.	Fifteen.
	Pounds.	Feet.						
Earth road,	200	8.9	1	1.3	1.7	2.0	2.3	2.7
Gravel road,	143½	6.4	1	1.5	1.9	2.4	2.9	3.3
Macadam road,	65	2.9	1	2.0	3.1	4.1	5.1	6.1
Telford road,	46	2.0	1	2.5	3.9	5.4	6.8	8.2
Plank road,	41	1.8	1	2.6	4.3	5.9	7.5	9.1
Stone track way,	12½	.5	1	6.4	11.7	17.1	22.3	27.5

TABLE II.

Tractive Force Required for Carriages of One Ton on a Level Road. (McConnell.)

Description of Road.	Force of Traction per Ton.
1. On rails,	8 pounds.
2. Well-made pavement,	33 pounds.
3. Macadamized road,	41 to 67 pounds.
4. Turnpike, hard and dry,	68 pounds.
5. Turnpike, dirty,	88 pounds.
6. Hard compact loam,	119 pounds.
7. Gravel,	150 pounds.
8. Sandy and gravelly,	210 pounds.
9. Ordinary by-road,	237 pounds.
10. Turnpike, newly gravelled,	320 pounds.
11. Loose sandy road,	457 pounds.

A horse produces his greatest mechanical effect in drawing a load two and one-half miles per hour with a tractive force of 150 pounds.

TABLE III.

Fraction of the Weight of a Vehicle and Load Required to Move Same on a Level Road. (Morin.)

Character of the Road.	2-wheeled carts.	Trucks, 4-wheeled, 3 and 4-horse.	4-horse stage coaches, on springs.		2-horse carriages, body on springs.	
Firm soil, covered with gravel 4 to 6 inches deep,	1-12	1-9	1-8		1-8	
Firm embankment covered with gravel 1¼ to 1½ inches deep,	1-16	1-11	1-10		1-10	
Earth embankment, in very good condition,	1-41	1-29	1-26		1-26	
Bridge flooring of thick oak plank,	1-70	1-46	1-14		1-42	
Broken Stone Road.			Walk.	Trot.	Walk.	Trot.
In very good condition, very dry, compact and even,	1-75	1-54	1-48	1-41	1-49	1-42
A little moist or a little dirty,	1-53	1-38	1-34	1-27	1-34	1-27
Firm, but with ruts and mud,	1-33	1-24	1-21	1-18	1-22	1-19
Very bad, ruts 4 to 4½ inches deep, thick mud,	1-19	1-14	1-12	1-10	1-12	1-10
Good pavement, dry,	1-90	1-65	1-57	1-38	1-59	1-39
Good pavement, covered with mud,	1-69	1-50	1-44	1-53	1-45	1-34

TABLE IV.

Tractive Power of Horses at Different Speed. (Trautwine.)

The average traction of a horse on a level and actually pulling for ten hours in the day may be assumed as follows:

Miles per Hour.	Pounds, Traction.	Miles per Hour.	Pounds, Traction.
¾	333.33	2¼	111.11
1	250	2½	100
1¼	200	2¾	90.91
1½	166.66	3	83.33
1¾	142.86	3½	71.43
2	125	4	62.50

If the horse works for a smaller number of hours, his traction may increase as the hours diminish down to about five hours per day and for speeds of about from one and one-fourth to three miles per hour.

TABLE V.

Effect of Inclination of Tractive Force. (U. S. Department of Agriculture.)

Rate of Inclination.	Angle with the level. ° ′ ″	Tractive force—pounds.	Equivalent length of level road in miles.
Level,	0 00 00	38	1.00
1 in 500,	0 6 53	42	1.10
1 in 100,	0 34 23	58	1.52
1 in 80,	0 42 58	63	1.66
1 in 60,	0 57 18	71	1.87
1 in 50,	1 08 16	78	2.05
1 in 40,	1 25 57	88	2.30
1 in 30,	1 54 37	104	2.73
1 in 25,	2 17 26	118	3.10
1 in 20,	2 51 21	138	3.63
1 in 15,	3 48 51	171	4.50
1 in 10,	5 42 58	238	6.26

The table gives the tractive force necessary to draw one ton over the best macadam road of various grades, and the equivalent length of each mile of grade in miles of level road.

The effect of the inclination can be calculated from the following formula:

$$R = F \times aW,$$

where F= force required to draw the load on the level, a = the grade, expressed by a fraction, W = the weight of the load in pounds, R = force required to draw the load up the incline in question.

According to Gillespie, if a horse can pull on a level 1,000 pounds, on a rise of:

1 foot in

100 feet he draws 900 pounds.
50 feet he draws 810 pounds.
44 feet he draws 750 pounds.
40 feet he draws 720 pounds.
30 feet he draws 640 pounds.
25 feet he draws 540 pounds.
24 feet he draws 500 pounds.
20 feet he draws 400 pounds.
10 feet he draws 250 pounds.

TABLE VI.

Effect of Surface on Tractive Force (Various Authorities, Compiled by Herring.)

Description of Road.	Tractive force—pounds.	Description of Road.	Tractive force—pounds.
Loose sand,	448	Very hard and smooth macadam,	46
Loose gravel (deep),	320	Best macadam,	52 to 32
Loose gravel (4 inches),	222	Cobblestone, ordinary,	140
Common gravel road,	147	Cobblestone, good,	75
Good gravel,	88	Belgian block,	56 to 26
Hard-rolled gravel,	75	Belgian block in Paris,	54 to 23
Ordinary dirt road,	224	Belgian block, good,	34½
Hard clay,	112	Stone block, ordinary,	90
Hard, dry dirt road,	89	Stone block, good,	45
Macadam, little used,	140 to 97	Stone block, London,	36
Macadam, bad,	160	Asphalt,	17
Macadam, poor,	112	Granite tramway,	12½ to 13½
Macadam, common,	64	Iron railway,	8 to 11½
Good macadam, net,	75 to 42		
Best French macadam,	45		

The velocity is in all cases taken at three miles per hour.

TABLE VII.

Cost of Hauling Farm Products in the United States.

	Average length of haul—miles.	Average weight of load for two horses—pounds.	Average cost per ton per mile.	Total cost per ton for whole length of haul.
Eastern states,	5.9	2,216	$0.32	$1.89
Northern states,	6.9	....	27	1.8[illegible]
Middle southern states,	*8.8	....	31	2.72
Cotton states,	12.6	1,397	25	3 05
Prairie states,	8.8	2,409	22	1.94
Pacific coast and mountain states,	23.3	2,197	22	5.12
Averages for United States,	12.1	2,002	$0.25	$3.02

*Middle states.

TABLE VIII.

Labor One Horse is Able to Perform at Different Rates of Speed on Canals, Railroads and Turnpikes. (Drawing Force 83 1-3 Miles.) (Waring.)

	Duration of day's work—hours.	Useful Effect for One Day Drawn One Mile. On a canal—tons.	On a railroad—tons.	On a turnpike—tons.
2½,	11½	520	115	14
3,	8	243	92	12
3½,	6	154	82	10
4,	4½	102	72	9
5,	2 9-10	52	57	7.3
6,	2	30	48	6
7,	1½	19	41	5
8,	1⅛	12.8	36	4.5
9,	9-10	9	32	4
10,	¾	6.5	28.8	3.6

The total weight of farm products in 1895 was estimated at 219,824,227 tons. If the forest products hauled over the public roads be added to this, we get 313,349,227 tons, which at $3.02 per ton, makes a total for the annual cost of hauling on the public roads of $946,414,665. Nearly, if not quite, two-thirds of this vast expense may be saved by road improvement, and this at a total cost not exceeding the losses of three, or at most, four years by bad roads. (Circular No. 19, Office of Road Inquiry, U. S. Dept. of Agri.)

TABLE IX.

Average Quantity of Stone Required per Year to Keep Ten Feet of Road Width = 20 Feet in Repair. (Herschel.)

	Cubic feet.	Cubic yards.
1. Good material and heavy travel,	15 — 20 =	.55 — .74
2. Good material and medium amount of travel,	10 — 15 =	.37 — .55
3. Good material and light travel,	5 — 10 =	.18 — .37
4. Medium material and heavy travel,	20 — 25 =	.74 — .92
5. Medium material and medium amount of travel,	15 — 20 =	.55 — .74
6. Medium material and light travel,	10 — 15 =	.37 — .55
7. Third-rate material and heavy travel,	25 — 30 =	.92 — 1.10
8. Third-rate material and medium amount of travel,	20 — 25 =	.74 — .92
9. Third-rate material and light travel,	15 — 20 =	.55 — .74

TABLE X.

Grades.

Degrees.	Feet of rise per mile.	Feet of rise per 100.
1,	92.16	1.7455
2,	184.4	3.4924
3,	276.7	5.2407
4,	369.2	6.9926
5,	461.9	8.7489
6,	555.0	10.5100

THE INFLUENCE OF WIDE TIRES ON DRAFT WAGONS.

BY H. J. WATERS, *Director of the Missouri Experiment State College, Formerly Professor of Agriculture in the Pennsylvania State College.*

In all suggestions for highway improvement, considerable stress has been laid upon the advantages accruing to the roads from the use of broad tires in lieu of the narrow tires so generally used. It is on all sides admitted that these narrow tired wheels are among the most destructive agents to the streets, macadam, gravel, and dirt roads, and to the fields, meadows and pastures of the farms.

To secure reliable information on this point, this Station under took to make careful comparisons of the draft of 1½ inch and 6 inch tires on dirt, gravel, and macadam roads, and on the plowed fields, meadows and pastures of the farm, in all conditions. It was proposed to have these trials cover an entire year, so as to be certain that they embraced all conditions of road surface usually found. This work was begun early in January, 1896, and was continued without interruption to September, 1897, actually covering more than twenty months. The tests were made with a Giddin s self-recording dynamometer registering a maximum strain of 3,000 pounds, and reading to approximately five pounds.

Results of Experiment.

I. Macadam Street.

Hard, smooth, nearly level, and comparatively free from dust, loose stone or sand. Length of runs 400 feet.

Trial made August 29, 1896.

	Average draft.
Narrow tire,	99.4 pounds.
Wide tire,	73.4 "
Difference in favor of broad tire,	26.0 "
Percentage difference,	35.7 "

Trial made September 12, 1896.

	Average draft.
Narrow tire,	143.5 pounds.
Wide tire,	123.4 "
Difference in favor of broad tire,	20.1 "

Contrary to general expectations the broad tire pulled the lighter on the hard, inelastic, smooth surface of the rock road.

In these trials there was a difference in draft in favor of the broad tires amounting to 26 pounds or 35.7 per cent. in one trial and 20.1 pounds, or 16.3 per cent. in another, or an average of 21 pounds, or 26 per cent., the trials being almost a month apart. In other words, with the draft required to draw 2,000 pounds over this road on narrow tired wheels a load of 2,714 pounds could have been hauled on the broad tires in one trial, and 2,322 pounds in the second trial, or 2,518 pounds as an average of both trials.

II. Gravel Road.

(a) Hard surface, no ruts, some loose stones size of black walnuts. Trial made October 12, 1896. Length of run, 400 feet.

	Average draft.	
Narrow tires,	218.4	pounds.
Broad tires,	163.8	"
Difference in favor of broad tires,	54.6	"
Percentage difference,	33.3	"

(b) Dry, hard and free from dust. A few loose stones lying on the surface. Length of run, 400 feet. Trial made November 20, 1896.

	Average draft.	
Narrow tires,	145.7	pounds.
Broad tires,	100.2	"
Difference in favor of broad tires,	45.5	"
Percentage difference,	45.4	"

(c) A large quantity of sand in the gravel which prevented it from packing perfectly. Road dry and free from ruts. Run made August 29, 1896. Length of run, 400 feet.

	Average draft.	
Narrow tires,	239.1	pounds.
Broad tires,	156.7	"
Difference in favor of broad tire,	72.4	"
Percentage difference in favor of broad tire,	45.5	"

(d) New. Before the gravel had become compacted, reasonably dry and firm. No ruts. Length of run, 400 feet. March 20, 1897.

	Average draft.	
Narrow tire,	329.9	pounds.
Broad tire,	260.5	"
Difference in favor of broad tire,	69.4	"
Percentage difference in favor of broad tire,	26.6	"

(e) Water standing on surface. Loose sand varied in depth from

1 to $2\frac{1}{2}$ inches. Wide tire forced most of the slush out of its track. No rut remained. Trial made October 12, 1896. Length of run, 400 feet.

	Average draft.	
Narrow tire,	262.3	pounds.
Broad tire,	268.1	"
Difference in favor of narrow tire,	5.8	"
Percentage difference in favor of narrow tire,	2.2	"

(f) Water standing on surface. Loose sand and gravel to a depth of about one inch, forming a slush, underlaid by hard roadbed. Both sets of wheels cut through to the solid roadbed. No rut formed. Length of run, 400 feet. March 19, 1897.

	Average draft.	
Narrow tire,	231.7	pounds.
Broad tire,	240.8	"
Difference in favor of narrow tire,	9.1	"
Percentage difference in favor of narrow tire,	4.	"

With the draft required to draw a 2,000 pound load over this gravel road on the narrow tires the following loads could have been hauled on 6 inch tires: In the first trial, 2,666 pounds; in the second trial, 2,908 pounds; in the third trial, 2,910 pounds; in the fourth trial, 2,532 pounds; in the fifth trial, 1,956 pounds; in the sixth trial, 1,920 pounds; or an average for the six trials of 2,482 pounds, an increase in the load capable of being hauled of 482 pounds on account of the saving of draft from the use of the broad tires.

III. Dirt Road.

(a) Dry, hard, free from ruts and dust, nearly level. Trial made August 28, 1896. Length of run, 400 feet.

	Average draft.	
Narrow tires,	137.3	pounds.
Broad tires,	104.8	"
Difference in favor of broad tires,	33.1	"
Percentage difference in favor of broad tires,	31.0	"

(b) Dry, hard, free from ruts or dust, nearly level. Trial made September 12, 1896. Length of run, 1,000 feet.

	Average draft.	
Narrow tires,	178.4	pounds.
Broad tires,	145.3	"
Difference in favor of broad tires,	33.1	"
Percentage difference in favor of broad tires,	22.7	"

(c) Clay road, dry, hard, ruts almost entirely obliterated; surface worn smooth. Trial made November 20, 1896. Length of run, 400 feet.

	Average draft.	
Narrow tires, ...	130.6	pounds.
Broad tires, ...	76.2	"
Difference in favor of broad tires, ...	54.4	"
Percentage difference in favor of broad tires, ...	71.4	"

Essentially the same conditions are met in these trials as were presented in the tests on macadam and gravel roads and the general results are the same. The broad tired wheels materially lessened the draft in all runs.

It will be observed that the draft is almost as light on the dirt road in this condition as on the macadam road in its best condition and is really less than on the gravel road in any condition in which tests were made.

On the dry dirt road the draft required to haul a 2,000 pound load with narrow tired wheels was capable of drawing 2,620 pounds in the first trial, 2,440 pounds in the second trial, 3,428 pounds in the third trial, and 2,829 pounds as an average of the three trials on the broad tired wheels.

(d) Dust 2 to 3 inches deep on the surface, very dry and loose, underlaid by hard smooth roadbed. Trials made September 15, 1897. Length of run, 300 feet and return.

	Average Draft. Run 1.	Average Draft. Run 2.	Average of both runs. Pounds.
Narrow tire, ...	92.4	88.6	90.5
Broad tire, ...	105.5	107.5	106.5
Difference in favor of narrow tire, ...	13.1	18.9	16
Percentage difference in favor of narrow tire, ...	....	....	17.6

(e) Clay road. Surface sticky, firm underneath. Fair hauling condition. Ruts 4 to 6 inches deep with walls and bottom hard and dry. First run made with narrow tires in original ruts. Broad tires run over narrow ruts. Length of run, 400 feet. Trial made January 9, 1897.

	Average draft.	
Broad tire, ...	308.	pounds.
Narrow tire, ...	206.1	"
Difference in favor of narrow tire, ...	$\cdot$101.9	"
Percentage difference in favor of narrow tire, ...	49.4	"

(f) Muddy on top, firm underneath. Mud about $2\frac{1}{2}$ inches deep, very sticky, adhering to the broad wheels. Soft enough to allow the narrow tires to cut through to solid ground with slight resistance. Trial made October 12, 1896. Length of run, 400 feet.

	Average draft.	
Narrow tires, ...	250.8	pounds.
Broad tires, ...	325.3	"
Difference in favor of narrow tires, ...	74.5	"
Percentage difference in favor of narrow tires, ...	29.7	"

(g) Clay road. Surface soft to a depth of 3 or 4 inches. Ruts cut by narrow tires in ordinary use of the road 5 to 6 inches deep with fairly firm bottom. Walls of ruts more or less soft and sticky. The narrow tired wheels were run in these ruts 4 times without appreciably deepening them. The broad tired wheels were run over the ruts forming a new rut 6 inches wide and about $3\frac{1}{2}$ inches deep in the soft clay on the surface. Trial made January 16, 1897.

	Average Draft.		
	First run.	Second run.	Average of both runs.
Broad tires, ...	490.8	382.0	436.4
Narrow tires, ...	340.1	330.0	335.0
Difference in favor of narrow tires, ...	150.7	52.0	101.4
Percentage difference, ...	44.3	15.8	30.3

It will be observed that in the second run of the broad tired wheels in their own rut the draft was materially reduced, the difference between the broad and narrow tires being but 52.0 pounds, or 15.8 per cent. as compared with a difference of 150.7 pounds, or 44.3 per cent. in the first run. The average draft of the broad tires was:

	1st Run, lbs.	2d Run, lbs.
Going, ...	560.8	384.0
Returning, ...	420.8	380.0
Average, ...	490.8	382.0

A difference in the average of the two runs of 108.8 pounds. A rain interrupted the experiment at this point, and prevented further tests of the broad tires in their own ruts.

(h) Clay road, wet and sloppy on surface, to depth of 3½ to 4 inches. Hard and dry underneath. Both wagons cut through mud, no ruts left. Trial made October 13, 1896. Length of run, 400 feet.

	Average draft.
Narrow tire,	286.5 pounds.
Broad tire,	406.3 "
Difference in favor of narrow tire,	119.8 "
Percentage difference in favor of narrow tire,	41.8 "

In every trial on a soft surface overlying a hard roadbed, the narrow tires show to an advantage. This advantage reaches its maximum when the soft covering of the road consists of sticky clay. Such a condition is met frequently for short periods in the spring, summer and fall, immediately after rain has fallen on a hard, dry road or when the road has thawed on the surface and remains frozen underneath. As explained in the case of the wet gravel road and dusty dirt road, this difference appears to be due to the fact that the narrow tires cut through the mud and roll on the hard roadbed underneath with very much less resistance than is encountered by the broad tires. In the nature of the case this condition of the road surface is of short duration. A few hours of sun will sufficiently dry this mud or sand so that it will pack under the broad tires instead of being pushed aside. In that condition the narrow tire is at its greatest disadvantage as compared with the broad tire as is clearly shown in the next trial on a dirt road drying on top.

(i) Black soil. Graded late in fall. Mud stiff and drying on top. Narrow tire made rut 3.5 inches deep in passing over the surface twice. Mud packed under the broad tires leaving scarcely any rut. Length of run, 400 feet. March 19, 1897.

	Average draft.
Narrow tire,	497.0 pounds.
Broad tire,	306.9 "
Difference in favor of broad tire,	190.1 "
Percentage difference in favor of broad tire,	61.6 "

(j) Clay road. Dry on top. Spongy underneath. A new track was made, the narrow tire being run first, the wide tires running over the rut cut by the narrow tires. Depth of rut made by narrow wheels, from 8 to 12 inches. Rut of wide tires 4 to 6 inches deep. Trial made February 28, 1896. Two runs. Length of runs 400 feet.

	Average Draft. First run.	Average Draft. Second run.	Average of both runs. Pounds.
Narrow tires,	466.7	478.5	472.6
Broad tires,	489.5	356.3	422.9
Difference in favor of broad tires,	—22.8	122.2	49.5
Percentage difference,	—4.7	34.3	11.9

(k) Clay road. Dry on top. Spongy underneath. Ruts in road before making trial, about 8 inches deep. Both sets of wheels run in the old ruts, narrow tires first. Ruts about 5 inches deep after broad wheels had passed over them once. Trial made February 24, 1896. Length of runs 400 feet.

	Average Draft. Run 2.	Average Draft. Run 1.	Average of both runs. Pounds.
Narrow tires,	614.4	577.2	595.8
Broad tires,	375.6	379.2	377.4
Difference in favor of broad tires,	238.8	189.0	218.4
Percentage difference,	63.6	52.2	57.9

(l) Clay road. Dry on top. Soft underneath. Three trials, the narrow and broad tire alternating over the same course and in the same track. Length of runs 400 feet. March 20, 1897.

	Average Draft. Trial 1—pounds.	Average Draft. Trial 2—pounds.	Average Draft. Trial 3—pounds.	Average of all trials. Pounds.
Narrow tires,	725.9	600.8	569.6	632.1
Broad tires,	547.6	507.3	512.5	522.5
Difference in favor of broad tires,	178.3	93.5	57.1	109.6
Percentage difference,	32.7	18.4	11.1	20.8
Depth of Rut Cut—Inches.				
Narrow tires,	6.0	5.5	4.9	
Broad tires,	2.6	3.6	2.5	

(m) Clay road. Mud deep, stiff, and beginning to dry on the surface. At one end of the run was soft mud on which water was standing. The narrow tire made a rut 7 inches deep. Length of run 400 feet. March 19, 1897.

	Average draft.
Narrow tires,	825.3 pounds.
Broad tires,	551.9 "
Difference in favor of broad tires,	273.4 "
Percentage difference in favor of broad tires,	49.3 "

(n) Clay road. Muddy, slightly frozen on top, but not enough to bear the load on either set of wheels. Narrow tires made ruts 12 inches deep in places. Length of run 400 feet.

	Average draft.
Narrow tires,	549.0 pounds.
Broad tires,	447.6 "
Difference in favor of broad tires,	101.4 "
Percentage difference,	22

(o) Clay road, very soft and sticky. Old ruts 18 inches deep, full of water. Narrow tire run first. Broad tire rut about 6 to 8 inches deep, and gathered the mud, filling the wheel. Trial made April 9, 1896. Length of run 400 feet.

	Average draft.
Narrow tires,	321.7 pounds.
Broad tires,	514.1 "
Difference in favor of narrow tire,	192.4 "
Percentage difference,	59

In this trial the mud was stiff enough to adhere to the rim and spokes of the wheels, and the difference in the amount of mud gathered and transported by the broad and narrow tires is so great that the draft of the broad tires was 59 per cent. higher than that of the narrow tires. After carefully watching the dirt roads in this locality for two years, this is the only time they were found in that condition.

In the two years covered by these trials, only two conditions of the dirt roads have been found in which the narrow tire pulled lighter than the broad tire, viz: when soft, either muddy or very dusty, on the surface and hard underneath; and when the mud was deep and sticky so that both sets of wheels cut deep ruts and the mud adhered to the wheels. In the nature of the case, both of these conditions of the road are of short duration. In all other conditions of dirt roads, the broad tire has shown a materially lighter draft than the narrow tire.

Clay road. Hard and dry. Ruts previously made by narrow tire 2.5 inches deep, with rough ridges of earth on either side. Walls of

ruts dry and rigid. Ruts worn smooth by use, and free from dust and loose dirt. Road in what would be termed fair hauling condition for narrow tired wagons. Narrow tires were run in old ruts in advance of the broad tires. Broad tires practically filled the ruts in four trips or two runs. Length of runs, 400 feet. Trials made November 10, 1896:

	Average Draft.		Average of both runs.
	First run.	Second run.	
Narrow tire,	129.2	124.8	127.0
Broad tire,	147.6	119.6	133.6
Difference in favor of narrow tire,	18.4	—5.2	6.7

In this case the ruts were 2½ inches deep and the disadvantage at which the broad tires operated was comparatively slight. In the first run there was a difference of but 18.4 pounds or 14.2 per cent. In the second run the order was reversed and the disadvantage caused by the rut was so far eliminated as to enable the user of the broad tire to draw his load over this road with less effort than the user of the narrow tire, the difference being 5.2 pounds, or 4.4 per cent. in favor of the broad tire. It is to be further noted that the use of the broad tire in the track of the narrow tire in the first run did not so increase the draft of the narrow tire as to cause this, since there was a slight reduction in the draft of the narrow tire in the second trial after the broad tires had been used as compared with the first run before they had been used. Clearly, therefore, a rut of this depth would be of little consequence.

For several weeks in the spring the ruts on dirt roads are usually considerably deeper than those in the foregoing trial and on that account these results were not considered sufficiently reliable to form the basis for a general conclusion. Therefore these additional tests were made:

Clay road, dry, cut into ruts by narrow tires in the ordinary course of travel. Surface of road, hard. The narrow tire ruts were an average of 8½ inches deep with smooth, rigid walls well apart so that the side friction on the narrow wheels was slight. The bottoms of the ruts were comparatively hard and smooth. On each side of rut was a ridge of loose, dry earth or baked clay about 2½ inches high. Length of runs, 400 feet. March 27, 1897.

In all cases a run means a round trip—going and returning.

The runs were made in the following order:

		Average draft.
Run 1.	Narrow tire in original rut,	342.8 pounds.
Run 2.	Narrow tire in original rut, (Rut not perceptibly deepened.)	331.7 "
Run 3.	Broad tire on the narrow tire rut,	521.0 "
Run 4.	Broad tire on the narrow tire rut,	342.8 "
Run 5.	Broad tire on the narrow tire rut,	335.0 "
Run 6.	Broad tire on the narrow tire rut, (Rut about 2 inches deep. Original narrow tire rut almost completely filled.)	326.5 "
Run 7.	Narrow tire over the same rut, (This run deepened the rut in the center about 2 inches more, making a total depth of 4 inches.)	414.8 "
Run 8.	Broad tire over the same rut, (Rut made by the narrow tire in run 7 completely filled.)	332.5 "
Run 9.	Narrow tire in same track, (Rut cut about one inch below the level of the broad tire rut.)	312.8 "
Run 10.	The broad tire completely obliterated the narrow tire rut,	320.5 "
Run 11.	Narrow tire made almost no rut in bottom of broad tire rut,	334.2 "
Run 12.	Narrow tire. Made little impression,	321.4 "
Run 13.	Broad tire. Rut two inches. The last runs did not seem to have any effect,	320.5 "

The six inch tires almost completely filled the narrow tire rut in four round trips. Thus at the same time that a ton load was being hauled over this road on the broad tires its surface was smoothed and improved. Every run with the broad tires was a benefit; every run with the narrow tires was an injury.

Clay road, dry on top; narrow tire ruts cut in the ordinary course of travel averaged $8\frac{1}{2}$ inches deep, except for a distance of 20 feet at one end of the run where the ruts were 15 inches deep; walls of ruts rigid, smooth and well spread; bottoms hard and smooth; the side friction on the narrow tired wheels very slight. Length of run 400 feet; net load, 2,000 pounds. These trials were made on the same ground as those just reported, the condition of the road being practicably the same, excepting that it was slightly dryer. Runs were made in the following order:

	Average draft.
Run 1. Narrow tire in original rut,	422.0 pounds.
Run 2. Narrow tire in original rut,	425.0 "
Run 3. Narrow tire in original rut,	425.0 "
Run 4. Narrow tire in original rut,	423.3 "
Run 5. Broad tires over the same rut,	493.2 "
Run 5. Broad tires over the same rut,	353.5 "
Run 7. Broad tires over the same rut,	324.4 "
Run 8. Broad tires over the same rut, (Old rut completely filled, and depression less than two inches deep made by the broad tires.)	322.5 "
Run 9. Narrow tire in broad tire track, (Deepened rut two inches.)	393.1 "
Run 10. Broad tire in same rut. (Completely filled narrow tire rut),	347.3 "
Run 11. Narrow tire in same rut. (Deepened broad tire rut almost two inches),	354.3 "
Run 12. Broad tire in same rut. (Completely filled narrow tire rut),	342.3 "
Run 13. Narrow tire run in same rut. (Cut rut less than one inch deep),	362.3 "

Here four round trip runs were made with the narrow tires in the original rut. The draft in each run is practically the same, showing that it was neither diminishing nor increasing when a ton load was hauled on the narrow tires, neither was the rut deepened by this use. At this point the broad tire was put on this rut. The first run of the broad tires shows an increased draft over the previous narrow tire runs of 69.6 lbs., or 16.4 per cent. In the first run, therefore, the user of the broad tires could haul but 2,000 pounds on a road in this condition with the same effort that the user of the narrow tires could haul 2,328. However, the second run of the broad tire in the same track shows a draft of only 353.5 pounds, a striking reduction when compared with the first run of the broad wheels, and also when compared with the average of the four runs with the narrow tires. The user of the broad tires could then haul with the same effort required to haul 2,000 pounds on the narrow tires a load of 2,451.5 pounds on the broad tires. Thus it appears that one run of the broad tires over this road was sufficient to materially decrease the draft of the vehicles passing along thereafter.

IV. Mowing Lands.

(a) Timothy sod. Dry, firm, smooth, freshly mown. Narrow tire cut ruts $\frac{3}{4}$ to 1 inch deep. No appreciable depression by broad tires. Length of run 400 feet.

Trial made July 2, 1896.

	Average draft.
Narrow tires,	317.3 pounds.
Broad tires,	228.8 "
Difference in favor of broad tires,	88.5 "
Percentage difference,	38.6

(b) Timothy sod. Soft. Surface frozen, but not enough to bear up the wagons. Length of run 400 feet.

Trial made February 8, 1896.

	Average draft.
Narrow tires,	563.2 pounds.
Broad tires,	461.1 "
Difference in favor of broad tires,	102.1 "
Percentage difference,	22.1

(c) Timothy sod. Grass and stubble about 3 inches high. Ground soft and spongy. Narrow wheels cut ruts 5 to 6 inches deep. Broad tires made ruts 1½ to 2 inches deep, doing almost no damage. Length of run, 400 feet.

Trial made April 9, 1896.

	Average draft.
Narrow tires,	569.1 pounds.
Broad tires,	323.6 "
Difference in favor of broad tires,	272.5 "
Percentage difference,	84

(d) Timothy sod, same as "(c)." Each set of wheels was run in its own track twelve times before reading was taken. Rut cut by narrow tire 12 to 15 inches; by broad tire, 4 to 5 inches. Length of run, 400 feet.

Trial made April 9, 1896.

	Average draft.
Narrow tires,	876 pounds.
Broad tires,	397.9 "
Difference in favor of broad tires,	478.1 "
Percentage difference,	120

(e) Timothy sod, moist but reasonably firm. Narrow tire cut rut 3½ inches deep, broad tire made rut from ¼ of an inch to one inch deep; length of run, 400 feet. Trial made March 19, 1897.

	Average draft.
Narrow tires,	420.8 pounds.
Broad tires,	305 "
Difference in favor of broad tires,	115.8 "
Percentage difference,	38.0

V. Pasture Land.

(a) Bluegrass sod; smooth, dry, firm. Neither set of wheels cut an appreciable rut. Trial made September 12, 1896. Length of run, 400 feet.

	Average draft.
Narrow tires,	195.8 pounds.
Broad tires,	154.8 "
Difference in favor of broad tires,	41.0 "
Percentage difference,	26.5

(b) Bluegrass sod. Dry, firm, smooth. No appreciable impression made by either set of wheels. Trial made October 13, 1896. Length of run, 400 feet.

	Average draft.
Narrow tires,	239.5 pounds.
Broad tires,	157.0 "
Difference in favor of broad tires,	82.5 "
Percentage difference,	52.5

(c) Bluegrass sod, soft. Depression made by broad wheels about one inch deep. Narrow tires made rut about three inches deep. Length of run, 400 feet. Trial made January 16, 1897.

	Average draft.
Narrow tires,	437.1 pounds.
Broad tires,	230.9 "
Difference in favor of broad tires,	207.2 "
Percentage difference,	89.7

(d) Bluegrass sod, moist but not soft. Rut cut by narrow tires 3 inches deep; broad tires rut from ¼ inch to 1 inch; length of run, 400 feet. Trial made March 19, 1897.

	Average draft.
Narrow tire,	401.5 pounds.
Broad tire,	316.2 "
Difference in favor of broad tire,	85.3 "
Percentage difference,	27.0

(e) Bluegrass sod, moist and somewhat softer than in the preceding run. Rut made by narrow tire four inches deep; rut made by broad tire from ¼ to 1 inch deep. For about twenty feet in this run the ground was so soft that the broad tire cut a rut from 1 to 2 inches deep. On the same spot the narrow tire rut was from 7 to 8 inches inches deep. Length of run, 400 feet. Trial made March 19, 1897.

	Average draft.
Narrow tires,	578.5 pounds.
Broad tires,	436.2 "
Difference in favor of broad tires,	142.3 "
Percentage difference,	32.6

As in the case of the mowing lands, five runs were made on bluegrass pastures, covering the different conditions of surface, with the same general result. The same principle holds good here that applies to meadows, and to any surface that is more or less firmly bound together by the roots of grass or weeds, viz: That where the

bearing surface of the wheel is large these roots tend to keep the wheel on the surface, prevent ruts being cut, and therefore materially reduce the draft. This is also true to a less degree of a surface covered with loose grass or other rubbish.

The difference in draft in favor of the broad tires in the runs on bluegrass sod varies from 26.5 per cent. on a hard, dry, smooth surface to 89.7 per cent. on a soft surface. Averaging all the trials on pasture lands, we find a saving in draft amounting to 116.4 pounds, or 45.7 per cent. due to the broad tires. Therefore, with the same effort required to draw one ton on the narrow tires over pasture land in these trials, a load of 2,914 pounds could have been drawn on the six inch tires.

VI. Stubble Land.

(a) Grown in cow peas the previous year; ground soft. Narrow tires cut ruts 14 inches deep first run. Broad tires cut rut about 3 to 4 inches deep. Four horses were required to pull the narrow tired wagon. Length of run, 400 feet. Trial made February 8, 1896.

	Average draft.
Narrow tires,	758.1 pounds.
Broad tires,	538.7 "
Difference in favor of broad tires,	219.4 "
Percentage difference,	40

(b) Wheat stubble. Dry, smooth and comparatively free from weeds. Neither set of wheels made appreciable ruts. Length of run, 400 feet. Trial made September 12, 1896.

	Average draft.
Narrow tires,	298.5 pounds.
Broad tires,	222 "
Difference in favor of broad tires,	76.5 "
Percentage difference,	34.4

(c) Corn stubble free from weeds, nearly dry enough to plow. Surface smooth and nearly level. Length of run, 400 feet. Trial made March 27, 1896.

	Average draft.
Narrow tires,	484.2 pounds.
Broad tires,	325.7 "
Difference in favor of broad tires,	158.5 "
Percentage difference,	48

(d) Corn stubble, same as "(c)." Draft record taken on the 14th run in same ruts, each set of wheels being run on its own track. Depth of rut: narrow tires 7 to 12 inches; broad tires 2 to 3½ inches. Length of run, 400 feet. Trial made March 27, 1896.

	Average draft.	
Narrow tires, ...	427	pounds.
Broad tires, ...	263.3	"
Difference in favor of broad tires, ...	159.5	"
Percentage difference, ...	59	

(e) Corn land dry enough to plow. Surface covered with dead grass and stalks. Almost level. Length of run, 400 feet. Trial made March 27, 1896.

	Average draft.	
Narrow tires, ...	422.7	pounds.
Broad tires, ...	361.9	"
Difference in favor of broad tires, ...	60.8	"
Percentage difference, ...	16.8	

(f) Corn land, dry, firm, level, and smooth. Reasonably free from weeds. Trial made September 12, 1896.

	Average draft.	
Narrow tires, ...	343.1	pounds.
Broad tires, ...	225.4	"
Difference in favor of broad tire, ...	117.7	"
Percentage difference, ...	52.2	

(g) Corn stubble in the fall. Land dry and reasonably firm. Broad tires made rut 1 to 2.5 inches deep. Narrow tires made rut 2 to 5.5 inches deep. Length of run, 400 feet. Trial made October 13, 1896.

	Average draft.	
Narrow tires, ...	472.9	pounds.
Broad tires, ...	285.6	"
Difference in favor of broad tires, ...	187.3	"
Percentage difference, ...	65.5	

(h) Corn stubble, nearly dry enough to plow and almost free from weeds and trash. Ruts made by narrow tires 5.6 inches deep; ruts made by broad tires, 1.45 inches deep. Length of run, 400 feet. Trial made March 20, 1897.

	Average draft.	
Narrow tires, ...	878.4	pounds.
Broad tires, ...	509.9	"
Difference in favor of broad tires, ...	368.5	"
Percentage difference, ...	72.2	

Eight separate trials were made on stubble land, embracing wet, medium and dry conditions. These trials included both wheat and corn stubble land. The results in every case are strikingly favorable to the broad tire. The difference varies from 16.8 to 72 per cent. The average difference for all the trials is 186.2 pounds, or 48.5 per cent. With the same effort, therefore, required to haul a ton over

the cornfields, wheat stubble, etc., of the farm on the narrow tires, a load of 2,970 pounds, could have been hauled on the broad tires without doing any perceptible damage to the fields.

VII. Plowed Ground.

(a) Not harrowed. Many large clods; surface rough. Large clods crushed by wide tires. Narrow tires pushed them aside. Trial made September 12, 1896.

	Average draft.	
Narrow tires,	509.9	pounds.
Broad tires,	382.6	"
Difference in favor of broad tires,	127	"
Percentage difference,	33.2	

(b) Same as "(a)" except ground prepared for seeding. Surface, smooth; fairly compact; fine tilth.

	Average draft.	
Narrow tires,	466.5	pounds.
Broad tires,	323	"
Difference in favor of broad tires,	143.3	"
Percentage difference,	44.3	

Two trials were made on plowed fields, one over freshly plowed ground before the clods had been reduced by tillage; the second on the same ground after it had been reduced to a fine tilth as for seeding. In the first trial on the freshly plowed ground, the difference in favor of the broad tire was 127.3 pounds, or 33.2 per cent. practically one-third less than the narrow tire. In the second trial the difference was 143.3 pounds, or 44.3 per cent. in favor of the broad tire.

Proper Width of Tire.

It is believed that the six inch tire will prove more satisfactory, all things considered, for a combination farm and road wagon than will any other width. The three or four inch tire is unsatisfactory in running over the ruts made by the narrow tires, inasmuch as these ruts are wide enough at the top to allow the four inch tire to sink down at least a portion of their depth, thereby greatly increasing the side friction and the draft. The six inch tire on the other hand will run over these ruts and in a few trips completely fill them. Again, the three or four inch tire on a road partially dry on top and spongy underneath will not show the same saving of draft as the six inch tire, inasmuch as deeper ruts will be cut by them. From every point of view the six inch tires will be very much more satisfactory for farm use. On the road, in but two conditions of the surface, would the four inch tires show a lighter draft than the six

inch tires, viz: (1) when the surface is soft and sticky underlaid by hard roadbed, and (2) when the mud is deep and stiff enough to adhere to the wheels. Attention has already been called to the fact that the dirt roads of the middle west are in either of these conditions for a comparatively short time in the year.

Both Axles Should be the Same Length.

The proposition to use broad tires and have the front axle enough shorter than the rear one to prevent the front and rear wheels from running in the same track, is believed to be unsound under ordinary circumstances, considered from the point of view of the user of the wagon. Unquestionably such an arrangement would prove very beneficial to the road, inasmuch as the rolling surface of the wheels would be doubled, but unless a large majority of the wagons used on the road were provided with broad tires and arranged with short front axles, and unless the condition of the average road be very much improved, the draft of those so equipped would be greatly increased. For farm purposes also the draft of a wagon arranged in this manner would be materially higher than if both axles were the same length and the wheels tracked. In addition to the disadvantage of increased draft, a difficulty in turning would be encountered which of itself would positively preclude the adoption of the suggestion, unless the form of our wagons be considerably modified. Putting six inch tires on the ordinary wagon increases the space required for turning, inasmuch as the rim of the broad wheel will strike the body of the wagon in turning very much quicker than would the rim of the narrow tired wheel. If the distance between the rim of the wheel and the wagon bed be further diminished by shortening the axle the difficulty in turning is further increased. Viewing this matter from the point of public interest, it would seem to be better policy to concentrate all efforts on the simple proposition of inducing the farmers and teamsters to use broad tires, and not complicate the question with features of doubtful value which would involve a material modification of the form of the wagons now built for common farm and road purposes, and more or less inconvenience to the users of the same.

Summary of Results.

Numerous tests of the draft of wide and narrow tired wagons have been made at this Station during the past two years, on macadam, gravel, and dirt roads in all conditions, and on meadows, pastures, and plowed fields both wet and dry. The draft has been determined by means of a self recording dynamometer. The net load was in every trial the same, viz., 2,000 pounds. Contrary to

public expectation, in a large majority of cases the draft was materially less when tires six inches in width were used than when the tests were made with tires of standard width, $1\frac{1}{2}$ inches. The following is a summary of the results:

I. On macadam street, as an average of the two trials made, a load of 2,518 pounds could have been hauled on the broad tires with the same draft that a load of 2,000 pounds required on the narrow tires.

II. Gravel road. In all conditions of the gravel road, except wet and sloppy on top, the draft of the broad tired wagon was very much less than that of the narrow tired wagon. Averaging the six trials, a load of 2,482 pounds could be hauled on the broad tires with the same draft required for a load of 2,000 pounds on the narrow tires.

III. Dirt roads. (a) When dry, hard, and free from ruts and dust, 2,530 pounds could have been hauled on the broad tires with the same draft required for 2,000 pounds on the narrow tires. (b.) When the surface was covered with two or three inches of very dry, loose dust, the results were unfavorable to the broad tires. The dust on the road in each of these trials was unusually deep. (c.) On clay road, muddy and sticky on the surface and firm underneath, the results were uniformly unfavorable to the broad tires. (d.) On clay road, with mud deep, and drying on top, or dry on top and spongy underneath. A large number of tests showed uniformly favorable to the broad tire. The difference amounted to from 52 to 61 per cent., or about 3,200 pounds could have been hauled on the broad tires with the same draft required to draw 2,000 pounds on the narrow tires. In this condition of road the broad tires show to their greatest advantage. As the road dries and becomes firmer, the difference between the draft of the broad and narrow tires gradually diminishes until it reaches about 25 to 30 per cent. on dry, hard smooth dirt, gravel or macadam road, in favor of the broad tire. On the other hand, as the mud becomes softer and deeper, the difference between the draft of the two types of wagons rapidly diminishes until the condition is reached when the mud adheres to both sets of wheels; here the advantage of the broad tire ceases entirely, and the narrow tires pull materially lighter. (e.) Clay road, surface dry, with deep ruts cut by the narrow tires in the ordinary use of the road. In every trial the first run of the broad tire over the narrow tire ruts has shown a materially increased draft when compared with that of the narrow tire run in its own rut. The second run of the broad tires in the same track where the rut is not deep completely eliminated this disadvantage, and showed a lighter draft for the broad tire than the narrow tire showed in the first run. Where the ruts were eight inches deep with rigid walls, three runs of the broad tires in its own track over the ruts were

required to eliminate this disadvantage. Three runs of the broad tire over this track have in all cases been sufficient, however, to so improve the road surface that both the broad and narrow tired wagons passed over this road with less draft than the narrow tires did in the original ruts. In addition to the saving of draft, the road was made very much more comfortable and pleasant for the users of light vehicles and pleasure carriages by the few runs of the six inch tire. Summing up all the tests on dirt roads, it appears that there are but three conditions on which the broad tires draw heavier than the narrow tires, viz., (1) when the road is sloppy, muddy or sticky on the surface and firm or hard underneath; (2) when the surface covered with a very deep loose dust and hard underneath; (3) when the mud is very deep and so sticky that it adheres to the wheels of both kinds of wagons. It appears that the dust must be extraordinarily deep to show a higher draft for the broad than the narrow tires. The three conditions just named, therefore, are somewhat unusual and of comparatively short duration. Through a majority of days in the year and at times when the dirt roads are most used and when their use is most imperative, the broad tired wagons pull materially lighter than the narrow tired wagons.

IV. A large number of tests on meadows, pastures, stubble land, corn ground, and plowed ground in every condition, from dry, hard and firm to very wet and soft, show without a single exception a large difference in draft in favor of the broad tires. This difference ranged from 17 to 20 per cent.

V. It appears that six inches is the best width of tire for a combination farm and road wagon, and that both axles should be the same length so that the front and hind wheels will run in the same track.

AGRICULTURE IN PENNSYLVANIA.

TWELFTH CENSUS OF THE UNITED STATES.

Hon. William R. Merriam, Director of the Census:

Sir: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture in the State of Pennsylvania, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December 31st next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land, under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of Pennsylvania, June 1, 1900, numbered 224,248, and were valued at $898,272,750. Of this amount $322,879,810, or 35.9 per cent., represents the value of buildings, and $575,392,940, or 64.1 per cent., the value of the land and improvements other than buildings. On the same date the value of farm implements and machinery was $50,917,240, and that of live stock, $102,439,183. These values, added to that of farms, give $1,051,629,173, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of all such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $207,895,600, of which amount $80,901,459, or 38.9 per cent., represents the value of animal products, and $126,994,141, or 61.1 per cent., the value of crops, including forest products cut or produced on farms. The

"total value of farm products" for 1899 exceeds that for 1889 by $86,567,252, or 71.3 per cent.; but a part of this gain is doubtless due to a more detailed enumeration in 1900 than in 1890.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $57,043,770, leaving $150,851,830 as the gross farm income for that year. The ratio which this amount bears to the "total value of farm property" is referred to in this bulletin as the "percentage of gross income upon investment." For Pennsylvania, in 1899, it was 14.3 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Pennsylvania.

Very respectfully,

L. G. POWERS,
Chief Statistician for Agriculture.

GENERAL STATISTICS.

Pennsylvania has a total land area of 44,985 square miles, or 28,790,400 acres, of which 19,371,014 acres, or 67.3 per cent., are included in farms.

The surface of Pennsylvania is greatly varied, but is everywhere more or less hilly. The western part, occupying about one-fourth of the area of the State, is a broad plateau, whose rolling surface is broken by occasional ranges of hills, and deeply furrowed by water courses. The southeastern portion, extending from the Delaware river to the Blue Ridge, is for the most part undulating and admirably adapted to the production of cereals.

Between these two sections, extending across the State from southwest to northeast, is a mountainous region, composed of the mountain chains which constitute the Appalachian system. The elevation of the greater part of these mountains is not more than 2,000 feet. They are intersected by numerous valleys, often of considerable length and breadth, but sometimes narrow and deep. The State is very well watered, and the soil, except in the mountains, is everywhere fertile, and even where least adapted to agriculture, is suitable for grazing purposes.

Number and Size of Farm.

The following table gives, by decades since 1850, the number of farms, the total and average acreage, and the per cent. of farm land improved:

TABLE 1.—Farms and Farm Average: 1850 to 1900.

Year.	Number of farms.	Number of Acres in Farms. Total.	Improved.	Unimproved.	Average.	Per cent. of farm land improved.
1900,	224,248	19,371,015	13,209,183	6,161,832	86.4	68.2
1890,	211,557	18,364,370	13,210,597	5,153,773	86.8	71.9
1880,	213,542	19,791,341	13,423,007	6,368,334	92.7	67.8
1870,	174,041	17,994,200	11,515,965	6,478,235	103.4	64.0
1860,	156,357	17,012,140	10,463,296	6,548,844	108.8	61.5
1850,	127,577	14,923,347	8,628,619	6,294,728	117.0	57.8

The total number of farms reported for 1900 shows an increase of 75.8 per cent. since 1850, and an increase of 6.0 per cent. in the last decade. This increase was more rapid than the increase in total acreage, involving a gradual decrease in the average size of farms.

The total acreage has increased slowly, the gain being but 29.8 per cent. since 1850, and 5.5 per cent. since 1890. The area of improved farm land increased at a more rapid rate than the total acreage until 1890, but the use of a more strict construction of the term "improved land" by the Twelfth Census resulted in a slight decrease for the last decade in the per cent. of farm land improved.

Farm Property and Products.

Table 2 presents a summary of the principal statistics relating to farm products for each census year, beginning with 1850.

TABLE 2.—Values of Specified Classes of Farm Property, and of Farm Products: 1850 to 1900.

Year.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farms products.*
1900,	$1,051,629,173	$898,272,750	$50,917,240	$102,439,183	$207,895,600
1890,	1,062,939,846	922,240,233	39,046,855	101,652,758	121,328,348
1880,	1,095,405,324	975,689,410	35,473,037	84,242,877	129,760,476
1870,†	1,194,786,853	1,043,481,582	35,658,196	115,647,075	‡183,946,027
1860,	754,166,275	622,050,707	22,442,842	69,672,726	....
1850,	464,098,693	407,876,099	14,722,541	41,500,053	....

*For year preceding that designated.
†Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished one-fifth.
‡Includes betterments and additions to live stock.

Though the total value of farm property was twice as great in 1900 as in 1850, a decrease of 1.1 per cent. is shown for the last decade. This decrease is due to a loss of 2.6 per cent. in the value of land, improvements, and buildings, as the value of implements and machinery increased 30.4 per cent. and that of live stock, 0.8 per cent. The value of farm products for 1899 exceeds that for 1889 by 71.3 per cent. but a part of this increase, and of that in the value of implements and machinery, is doubtless due to a more detailed enumeration in 1900 than heretofore.

County Statistics.

Table 3 gives a statement of general agricultural statistics by counties.

TABLE 3.—Number and Acreage of Farms, and Values of Specified Classes of Farm Property, June 1, 1900, With Value of Products of 1899 Not Fed to Live Stock, and Expenditures in 1899 for Labor and Fertilizers, by Counties.

Counties.	Number of Farms.		Acres in Farms.		Values of Farm Property.				Gross income (products of 1899 not fed to live stock).	Expenditures.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	224,248	220,869	19,371,015	13,209,183	$575,392,940	$322,879,810	$50,917,240	$102,439,183	$150,851,830	$16,647,730	$4,685,920
Adams,	2,336	3,319	281,528	224,680	6,123,830	$4,349,030	$753,780	$1,489,899	$2,288,708	$223,990	$117,090
Allegheny,	5,565	5,491	350,596	282,961	39,075,980	9,298,150	1,382,430	2,297,928	4,870,914	575,450	116,760
Armstrong	4,202	4,117	367,867	277,262	8,541,640	3,970,770	705,630	1,576,189	1,962,072	116,770	45,570
Beaver,	2,602	2,528	248,973	185,706	9,104,210	3,311,440	576,939	1,231,239	1,604,652	137,960	31,180
Bedford,	3,615	3,569	480,241	268,514	5,960,265	3,167,170	626,100	1,440,765	1,948,438	121,590	46,300
Berks,	7,375	7,299	461,090	390,703	15,446,830	13,653,240	1,883,350	3,481,690	5,567,282	739,200	133,150
Blair	1,726	1,689	204,169	122,276	4,625,200	2,263,210	373,050	788,435	1,329,790	143,250	27,480
Bradford,	6,679	6,593	636,234	447,750	11,596,340	7,387,180	1,464,000	3,078,928	4,163,892	387,620	45,220
Bucks,	6,302	6,229	358,292	301,693	11,301,080	14,890,970	2,366,580	3,136,516	5,504,257	929,180	337,160
Butler,	5,350	5,222	444,105	335,689	11,951,090	5,878,180	1,021,240	2,159,876	2,481,327	130,690	54,960
Cambria,	2,566	2,529	245,525	140,180	5,723,470	2,716,940	526,510	944,695	1,472,029	114,310	39,790
Cameron,	387	386	40,817	12,671	398,450	258,580	49,080	113,552	164,422	16,020	2,120
Carbon,	1,042	1,030	116,721	44,298	1,429,620	1,378,520	223,930	241,354	571,065	81,050	32,180
Centre,	2,339	2,306	297,564	185,504	6,963,200	3,186,220	675,710	1,258,764	1,664,783	204,130	26,260
Chester,	6,262	6,069	447,309	371,425	17,181,000	16,584,720	2,178,800	3,988,267	6,365,741	1,141,870	370,380
Claron,	3,192	3,162	281,546	195,544	4,719,460	3,082,370	568,100	1,216,762	1,464,446	95,570	47,490
Clearfield,	3,452	3,386	289,300	167,234	5,372,910	3,026,770	585,710	1,101,460	1,527,356	107,270	38,770

TABLE 3—Continued.

Counties.	Number of Farms.		Acres in Farms.		Values of Farm Property.				Gross income (products of 1899 not fed to live stock).	Expenditures.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
Clinton,	1,362	1,337	134,373	72,465	2,663,500	1,541,330	295,500	514,225	925,872	90,260	18,330
Columbia,	2,760	2,741	231,151	165,803	4,182,100	[illegible]	[illegible]	984,913	[illegible]	[illegible]	94,830
Crawford,	7,894	7,704	597,527	368,237	13,219,080	6,811,850	1,380,780	3,563,131	3,768,082	263,660	62,400
Cumberland,	3,066	3,026	285,256	231,533	9,034,070	5,310,470	747,980	1,648,229	2,465,993	255,290	70,310
Dauphin,	[illegible]	2,810	233,545	178,887	8,553,560	5,081,330	664,405	1,345,186	2,269,048	259,630	72,145
Delaware,	1,677	1,663	92,498	77,005	13,602,370	6,803,270	596,940	1,254,742	2,101,247	414,000	85,600
Elk,	996	974	81,034	35,040	1,499,080	866,960	158,030	323,532	414,024	26,320	11,670
Erie,	5,957	5,818	459,861	286,480	14,087,150	6,516,850	1,244,910	2,800,885	3,710,386	427,210	116,840
Fayette,	[illegible]	[illegible]	402,283	262,720	15,905,400	5,408,220	709,810	1,710,906	2,441,106	262,450	54,610
Forest,	587	575	58,522	21,439	660,380	434,210	77,300	179,035	202,418	20,270	3,570
Franklin,	3,795	3,761	395,319	295,426	11,408,030	6,181,530	943,150	1,967,520	3,021,556	384,870	91,980
Fulton,	1,451	1,445	199,068	105,420	1,386,290	796,640	193,390	484,767	656,583	49,590	31,390
Greene,	3,294	3,239	354,204	306,334	13,644,580	3,568,650	512,380	2,257,172	2,129,298	119,540	13,640
Huntingdon,	2,425	2,396	363,711	199,020	3,740,380	2,480,550	452,190	1,090,489	1,488,174	140,410	29,700
Indiana,	4,475	4,420	466,065	337,635	10,302,300	4,316,210	796,900	1,927,685	2,285,746	115,860	48,850
Jefferson,	3,042	2,990	257,441	164,651	5,517,320	2,886,210	499,550	1,078,546	1,442,857	78,310	38,450
Juniata,	1,555	1,523	178,186	103,705	2,757,150	1,647,060	263,040	586,334	919,172	80,790	30,940
Lackawanna,	1,855	1,827	150,722	72,347	4,275,500	2,380,850	405,400	811,978	1,339,973	175,720	24,400
Lancaster,	9,437	9,343	552,761	478,325	30,791,730	23,147,820	2,916,770	5,071,838	9,210,815	1,162,610	366,700
Lawrence,	2,639	2,567	215,969	160,313	7,147,190	3,482,740	528,680	1,325,019	1,638,371	114,280	22,560
Lebanon,	2,560	2,516	169,975	147,368	7,545,180	4,569,050	535,545	1,260,748	1,800,990	235,500	59,175
Lehigh,	3,299	3,287	189,897	166,244	8,270,920	6,242,830	983,500	1,520,301	2,584,281	293,200	74,960
Luzerne,	3,295	3,231	256,577	151,654	7,967,740	3,879,710	708,490	1,128,461	2,082,327	308,750	79,200
Lycoming,	3,782	3,727	366,829	214,396	7,763,670	4,490,250	898,700	1,458,388	3,141,770	215,970	68,690

McKean,	1,877	1,827	162,897	72,317	2,645,530	1,590,620	275,060	763,350	844,385	98,530	8,840
Mercer,	4,956	4,905	397,952	285,812	10,704,830	5,361,450	937,570	2,474,671	2,737,407	172,930	4,2870
Mifflin,	1,249	1,232	157,294	97,538	3,386,120	1,665,920	298,300	636,347	964,508	90,750	15,700
Monroe,	2,057	2,036	241,020	106,278	2,085,090	2,628,660	399,940	620,604	984,392	89,550	30,730
Montgomery,	5,860	5,740	270,769	239,764	25,269,160	19,080,400	2,184,410	2,747,132	2,258,974	1,079,490	172,680
Montour,	842	837	75,971	60,648	2,089,360	1,133,750	246,770	397,463	664,111	78,300	34,960
Northampton,	3,538	3,483	191,378	166,820	7,006,010	6,399,540	919,310	1,404,632	2,432,743	273,110	64,540
Northumberland,	2,604	2,560	214,214	167,428	5,479,105	3,590,670	616,760	974,766	1,844,439	192,600	72,790
Perry,	2,286	2,274	257,732	151,620	3,567,860	2,239,740	042,280	840,599	1,258,575	99,310	44,790
Philadelphia,	1,072	1,025	36,002	31,978	21,418,120	4,008,860	537,550	480,090	2,152,660	692,010	135,590
Pike,	899	888	130,821	30,662	1,311,640	1,081,740	154,230	274,221	401,641	42,620	5,890
Potter,	2,434	2,406	264,723	124,271	3,596,000	2,029,000	417,770	1,051,785	1,276,649	108,830	8,610
Schuylkill,	3,011	2,963	223,434	141,135	4,923,340	3,691,970	650,060	1,003,656	2,045,561	240,370	124,740
Snyder,	1,854	1,829	153,985	111,889	3,303,610	1,778,250	345,680	625,556	1,001,071	66,390	35,950
Somerset,	3,782	3,719	513,395	279,970	8,732,410	4,181,830	792,930	1,812,969	2,370,114	193,560	91,390
Sullivan,	979	967	99,935	52,570	1,224,820	914,090	176,140	411,651	436,009	20,000	8,290
Susquehanna,	4,675	4,611	490,026	328,076	6,548,760	5,004,350	873,610	2,415,451	2,775,022	235,150	26,690
Tioga,	4,829	4,782	460,874	291,353	8,435,250	4,971,960	1,062,800	2,143,006	2,908,844	231,810	26,990
Union,	1,521	1,518	113,412	88,177	3,692,870	2,034,310	360,940	623,244	967,701	99,460	21,490
Venango,	3,273	3,198	277,378	166,810	5,283,440	2,860,370	530,100	1,157,803	1,360,591	123,110	37,770
Warren,	3,238	3,163	276,562	131,545	3,943,340	2,512,160	475,810	1,304,483	1,364,873	101,190	17,640
Washington,	4,742	4,637	526,701	451,705	25,935,300	8,500,770	1,150,120	3,522,645	3,910,480	300,230	40,840
Wayne,	3,663	3,597	386,536	145,505	4,991,840	3,602,430	638,690	1,664,623	1,856,425	153,190	17,990
Westmoreland,	5,402	5,342	515,729	397,385	20,786,820	8,527,570	1,349,530	2,867,619	3,776,966	302,080	65,600
Wyoming,	1,752	1,720	168,780	109,484	3,091,300	1,961,850	328,970	742,879	1,034,746	98,280	3,380
York,	8,091	8,024	519,354	421,897	14,571,770	11,250,050	1,721,560	3,577,586	5,609,691	541,510	383,300

In nearly all counties the number of farms increased in the last decade. Eleven counties report slight decreases. Except in eight counties, situated mostly in the southern part of the State, the total farm acreage also shows a general increase since 1890. The decrease in improved acreage reported in a number of counties, is due to a more intensive cultivation of smaller areas, and to the use of a more strict construction of the term "improved land" by the Twelfth than by any preceding census. The average size of farms for the State is 86.4 acres, and varies from 33.6 acres in Philadelphia county, to 149.8 acres in Huntingdon county. It is smallest in the extreme southeastern counties, which are devoted to dairying and truck farming, and contain a majority of the florists' establishments of the State.

For the State, the average value of farms is $4,006. Less than half of the counties report increases in farm values since 1890, but an increase in the value of implements and machinery is reported in all counties. The value of live stock averages $457 per farm, having increased since 1890 in more than half of the counties.

The average expenditure for labor in 1899 was $74 per farm. It was greatest in the counties where floriculture, dairying, and market gardening prevailed. The average expenditure for fertilizers increase.

Farm Tenure.

Table 4 gives a comparative statement of farm tenure for 1880, and 1900. Tenants are divided into two groups: "Cash tenants," who pay a rental in cash, or a stated amount of labor or farm produce, and "share tenants," who pay as rental a stated share of the products.

In Table 5 the tenure of farms in 1900 is given by race of farmer, and "farms operated by owners" are subdivided into four groups, designated as "owners," "part owners," "owners and tenants," and "managers." These terms denote, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other, or others, owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—Number and Per Cent. of Farms of Specified Tenures: 1880 to 1900.

Year.	Total number of farms.	Number of Farms Operated by— Owners.*	Cash tenants.	Share tenants.	Per Cent. of Farms Operated by— Owners.*	Cash tenants.	Share tenants.
1900,	224,248	165,982	23,737	34,529	74.0	10,6	15.4
1890,	211,557	162,219	18,040	31,298	76.7	8.5	14.8
1880,	213,542	168,220	17,049	28,273	78.8	8.0	13.2

*Including "part owners," "owners and tenants," and "managers."

TABLE 5.—Number and Per Cent. of Farms of Specified Tenures, June 1, 1900, Classified by Race of Farmer.

Part 1.—Number of Farms of Specified Tenures.

Race.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State,	224,248	153,031	7,074	2,174	3,703	23,737	34,529
White,	223,657	152,707	7,048	2,173	3,680	23,592	34,457
Colored,*	591	324	26	1	23	145	72

Part 2.—Per Cent. of Farms of Specified Tenures.

The State,	100.0	68.2	3.2	1.0	1.6	10.6	15.4
White,	100.0	68.3	3.2	1.0	1.6	10.5	15.4
Colored,*	100.0	54.8	4.4	0.2	3.9	24.5	12.2

*Comprising 6 Indians and 585 negroes.

The number of farms in Pennsylvania has increased 10,706, or 5.0 per cent. during the last two decades. During this period the farms operated by owners decreased 2,238, or 1.3 per cent., though the last decade shows an increase of 3,863, or 2.3 per cent.; the number

operated by cash tenants increased 6,688, or 39.2 per cent.; and that by share tenants increased 6,256, or 22.1 per cent. The increases shown for the tenant classes have been continuous through both decades.

Of the farms of the State, 99.7 per cent. are operated by white farmers, and only 0.3 per cent. by colored farmers. Of the white farmers, 72.5 per cent. own all or part of the farms they operate, and 27.5 per cent. operate farms owned by others. For the colored farmers, the corresponding percentages are 59.4 and 40.6, respectively.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number of farms conducted by the last-named class is constantly increasing.

Farms Classified by Race of Farmer and by Tenure.

Tables 6 and 7 present the principal statistics for farms classified by race and by tenure.

TABLE 6.—Number and Acreage of Farms and Value of Farm Property, June 1, 1900, Classified by Race of Farmer and by Tenure, With Percentages.

Race of Farmer and Tenure.	Number of farms.	Number of Acres in Farms.			Value of Farm Property.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State,	224,248	86.4	19,371,015	100.0	$1,051,629,173	100.0
White farmers,	223,657	86.5	19,345,274	99.9	1,049,589,533	99.8
Colored farmers,*	591	43.6	25,741	0.1	2,039,640	0.2
Owners,	153,031	78.2	11,972,838	61.8	607,750,011	57.8
Part owners,	7,074	120.3	850,820	4.4	41,461,917	3.9
Owners and tenants,	2,174	118.7	258,065	1.3	12,071,075	1.1
Managers,	3,703	145.6	539,046	2.8	44,924,460	4.3
Cash tenants,	23,737	76.7	1,819,478	9.4	141,888,955	13.5
Share tenants,	34,529	113.8	3,930,768	20.3	203,532,755	19.4

*Comprising 6 Indians and 585 negroes.

TABLE 7.—Average Values of Specified Classes of Farm Property, and Average Gross Income per Farm, With Per Cent. of Gross Income Per Farm, With Per Cent. of Gross Income on Total Investment in Farm Property, Classified by Race of Farmer and by Tenure.

Race of Farmer and Tenure.	Average Values per Farm of— Farm Property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent. of gross income on total investment in farm property.
The State,	$2,566	$1,440	$227	$457	$673	14.3
White farmers,	$2,567	$1,441	$228	$457	$673	14.4
Colored formers,*	2,150	910	112	279	360	10.4
Owners,	$2,027	$1,317	$211	$416	$605	15.2
Part owners,	3,482	1,539	265	575	846	14.4
Owners and tenants,	3,073	1,625	270	584	798	14.4
Managers,	7,522	3,377	402	831	1,118	9.2
Cash tenants,	3,848	1,480	212	438	704	11.8
Share tenants,	3,322	1,715	280	578	860	14.6

*Comprising 6 Indians and 585 negroes.

Nearly 70 per cent. of all farms in the State are operated by owners, who also control about 60 per cent. of the acreage and values of farm property. Farms operated by managers, though comparatively few in number, are larger in area and have higher average values of all forms of farm property than any other class. Their gross income, however, is smaller than that of the other groups.

Colored farmers occupy an insignificant place in the agriculture of the State, controlling only 0.3 per cent. of the farms, and 0.1 per cent, and 0.2 per cent. respectively, of the total acreage and value.

Farms Classified by Area.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—Number and Acreage of Farms, and Value of Farm Property, June 1, 1900, Classified by Area, With Percentages.

Area.	Number of farms.	Number of Acres in Farms.			Value of Farm Property.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State, ...	224,248	86.4	19,371,015	100.0	$1,051,629,173	100.0
Under 3 acres, ...	2,737	1.6	4,424	*	6,153,157	0.6
3 to 9 acres, ...	14,419	6.0	85,982	0.4	30,078,199	2.9
10 to 19 acres, ...	17,882	13.9	249,380	1.3	42,843,425	4.1
20 to 49 acres, ...	41,575	33.5	1,392,167	7.2	122,268,356	11.6
50 to 99 acres, ...	69,670	70.6	4,917,987	25.4	291,902,655	27.8
100 to 174 acres, ...	57,800	126.4	7,308,029	37.7	359,518,853	34.2
175 to 259 acres, ...	14,151	204.1	2,887,951	14.9	121,385,393	11.5
260 to 499 acres, ...	5,088	322.3	1,640,093	8.5	56,938,894	5.4
500 to 999 acres, ...	688	615.2	423,229	2.2	14,136,425	1.3
1,000 acres and over, ...	238	1,940.2	461,773	2.4	6,403,816	0.6

*Less than one-tenth of 1 per cent.

TABLE 9.—Average Values of Specified Classes of Farm Property, and Average Gross Income Per Farm, with Per Cent. of Gross Income on Total Investment in Farm Property, Classified by Area.

Area.	Average Values per Farm of—					Per cent. of gross income on total investment in farm property.
	Farm Property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State, ...	$2,566	$1,440	$227	$457	$673	14.3
Under 3 acres, ...	855	1,233	73	87	518	23.1
3 to 9 acres, ...	949	948	76	113	282	13.5
10 to 19 acres, ...	11,180	968	94	154	303	12.6
20 to 49 acres, ...	1,512	1,043	138	248	413	14.0
50 to 99 acres, ...	2,190	1,345	226	429	632	15.1
100 to 174 acres, ...	3,518	1,788	314	660	919	14.8
175 to 259 acres, ...	5,137	2,185	386	870	1,178	13.7
260 to 499 acres, ...	7,064	2,567	442	1,118	1,386	12.4
500 to 999 acres, ...	14,043	4,371	584	1,549	1,940	9.4
1,000 acres and over, ...	19,420	4,914	740	1,833	2,294	8.5

The group of farms containing from 50 to 99 acres each includes a larger number of farms than any other, but the group containing from 100 to 174 acres comprises more than one-third of the total farm acreage, and the same proportion of the values of farm property of the State.

With few exceptions, the average values of all forms of farm property increase with the size of the farms. The farms containing less than three acres are an exception to this rule, in the value of buildings and in gross income, this class containing most of the florists' establishments of the State, and many city dairies and market gardens. The incomes from these industries depend less upon the acreage of owned or rented land used than upon the capital invested in buildings, implements, and live stock, and the expenditures for labor and fertilizers.

The average value per acre of the gross income for the various groups of farms classified by area is as follows: Farms under 3 acres, \$320.66; 3 to 9 acres, \$47.21; 10 to 19 acres, \$21.70; 20 to 49 acres, \$12.33; 50 to 99 acres, \$8,96; 100 to 174 acres, \$7.27; 175 to 259 acres, \$5.77; 260 to 499 acres, \$4.30; 500 to 999 acres, \$3.15; and 1,000 acres and over, \$1.18.

Farms Classified by Principal Source of Income.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income.

If the value of the hay and grain raised on any farm exceeds that of any other crop, and constitutes at least 40 per cent. of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm. Similarly, if vegetables are the leading crop, constituting 40 per cent. of the value of products, it is "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive their principal income from any one class of farm products. Farms with no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—Number and Acreage of Farms and Value of Farm Property, June 1, 1900, Classified by Principal Source of Income With Percentages.

Principal Source of Income.	Number of farms.	Number of Acres in Farms.			Value of Farm Property.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State,	224,248	86.4	19,371,015	100.0	$1,051,629,173	100.0
Hay and grain,	30,832	109.8	3,824,292	17.5	180,457,842	17.2
Vegetables,	6,963	47.7	332,033	1.7	44,632,747	4.2
Fruits,	3,577	49.1	175,800	0.9	15,505,046	1.5
Live stock,	75,995	84.4	6,413,808	33.1	305,224,365	29.0
Dairy produce,	32,600	86.0	2,803,670	14.5	193,102,562	18.4
Tobacco,	2,074	60.1	124,663	0.6	13,257,931	1.3
Sugar,	24	537.8	12,907	0.1	301,149	*
Flowers and plants,	734	6.5	4,745	*	6,894,985	0.6
Nursery products,	95	61.1	5,801	*	990,169	0.1
Miscellaneous,	71,363	85.7	6,113,296	31.6	291,262,377	27.7

*Less than one-tenth of 1 per cent.

TABLE 11.—Average Values of Specified Classes of Farm Property, and Average Gross Income Per Farm, With Per Cent. of Gross Income on Total Investment in Farm Property, Classified by Principal Source of Income.

Principal Source of Income.	Average Values per Farm of—					Per cent. of gross income on total investment in farm property.
	Farm Property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State,	$2,566	$1,440	$227	$457	$673	14.3
Hay and grain,	$3,497	$1,668	$246	$444	$730	12.5
Vegetables,	4,423	1,487	226	264	762	11.9
Fruits,	2,589	1,348	176	222	614	14.2
Live stock,	2,069	1,264	207	476	580	14.4
Dairy produce,	3,217	1,782	289	635	889	15.0
Tobacco,	3,236	2,370	286	500	1,108	17.3
Sugar,	10,431	1,281	280	556	782	6.2
Flowers and plants,	5,049	4,023	244	78	3,017	32.1
Nursery products,	7,243	2,703	229	248	5,301	50.9
Miscellaneous,	2,158	1,317	212	394	599	14.7

For the several classes of farms, the average values per acre of products not fed to live stock are as follows: For farms whose operators derive their principal income from flowers and plants, $466.69; nursery products, $86.81; tobacco, $18.43; vegetables, $15.98; fruits, $12.49; dairy produce, $10.34; miscellaneous, $7.00; live stock, $6.87; hay and grain, $6.65; and sugar, $1.45. In computing these averages, the total area is used, and not merely the area devoted to the crop from which the principal income is derived.

The wide variations shown in the average gross income and in the percentage of gross income upon investment, are due largely to the fact that in computing gross incomes no deduction is made for expenditures. For florists' establishments, nurseries, and market gardens, the average expenditures for such items as labor and fertilizers represent a far larger percentage of the gross income than in the case of "hay and grain," "live-stock," or "miscellaneous" farms. Were it possible to present the average net income, the variations shown would be comparatively slight.

Farms Classified by Reported Value of Products not Fed to Live Stock.

Tables 12 and 13 present data relating to farms classified by the reported value of products not fed to live stock.

TABLE 12.—Number and Acreage of Farms, and Value of Farm Property, June 1, 1900, Classified by Reported Value of Products Not Fed to Live Stock, With Percentages.

Value of Products Not Fed to Live Stock.	Number of farms.	Number of Acres in Farms.			Value of Farm Property.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State,	224,248	86.4	19,371,015	100.0	$1,051,629,173	100.0
$0,	459	61.0	27,999	0.2	$1,365,910	0.1
$1 to $49,	2,724	33.1	90,229	0.5	4,819,740	0.4
$50 to $99,	7,637	31.5	240,200	1.2	11,499,720	1.1
$100 to $249,	41,494	41.1	1,706,484	8.8	75,465,530	7.2
$250 to $499,	63,681	65.9	4,198,914	21.7	191,076,755	18.2
$500 to $999,	65,515	104.7	6,862,020	35.4	326,665,378	31.1
$1,000 to $2,499,	38,454	141.6	5,443,775	28.1	351,587,360	33.4
$2,500 and over,	4,284	187.1	801,394	4.1	89,148,780	8.5

TABLE 13.—Average Values of Specified Classes of Farm Property, and Average Gross Income Per Farm, With Per Cent. of Gross Income on Total Investment in Farm Property, Classified by Reported Value of Products Not Fed to Live Stock.

Value of Products Not Fed to Live Stock.	Average Values per Farm of— Farm Property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent. of gross income on total investment in farm property.
The State,	$2,566	$1,440	$227	$457	$673	14.3
$0,	2,028	747	39	162	....	....
$1 to $49,	1,185	478	34	72	37	2.1
$50 to $99,	812	566	42	86	80	5.3
$100 to $249,	929	678	73	139	177	9.7
$250 to $499,	1,550	1,003	145	303	367	12.2
$500 to $999,	2,658	1,534	261	533	710	14.2
$1,000 to $2,499,	5,130	2,656	455	902	1,446	15.8
$2,500 and over,	13,162	5,215	841	1,592	4,035	19.4

Of the 459 farms reporting no income in 1899, some were summer homes and a few were abandoned farms. Some were farms which had changed owners or tenants shortly before the date of enumeration and for which the occupants, June 1, 1900, could furnish no definite information concerning the products of the previous year. To this extent, the reports fall short of giving a complete exhibit of farm income in 1899.

Live Stock.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the census of 1900. The age grouping for neat cattle is determined by their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits a very close comparison with the previous census reports.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—Domestic Animals, Fowls and Bees, on Farms, June 1, 1900, with Total and Average Values and Number of Domestic Animals Not on Farms.

Live Stock.	Age in Years.	On Farms.			Not on Farms.
		Number.	Value.	Average value.	Number.
Calves,	Under 1,	421,323	$3,032,067	$7.20	9,351
Steers,	1 and under 2,	108,681	1,739,459	16 01	1,787
Steers,	2 and under 3,	64,252	1,903,405	29 62	1,432
Steers,	3 and over,	16,382	712,704	43 51	1,720
Bulls,	1 and over,	69,006	1,607,337	23 29	934
Heifers,	1 and under 2,	224,623	3,705,397	16 50	5,420
Cows kept for milk,	2 and over,	943,773	29,141,561	30 88	78,301
Cows and heifers not kept for milk,	2 and over,	48,807	1,221,261	25 02	1,400
Colts,	Under 1,	28,547	806,696	28 26	878
Horses,	1 and under 2,	36,584	1,916,501	52 39	1,371
Horses,	2 and over,	525,850	38,225,630	72 69	218,006
Mule colts,	Under 1,	1,144	45,876	40 10	50
Mules,	1 and under 2,	3,604	210,286	58 35	183
Mules,	2 and over,	33,311	2,651,528	79 60	21,977
Asses and burros,	All ages,	576	22,559	39 16	601
Lambs,	Under 1,	571,583	1,327,924	2 32	2,460
Sheep (ewes),	1 and over,	769,463	2,651,067	3 45	6,789
Sheep (rams and wethers),	1 and over,	190,020	663 615	3 49	818
Swine,	All ages,	1,107,981	5,830,295	5 26	157,346
Goats,	All ages,	2,197	8,951	4 07	6,548
Fowls:*					
Chickens,†		10,553,106			
Turkeys,		259,824			
Geese,		60,780			
Ducks,		171,271			
Bees (swarms of),			4,483,486	....	....
		161,670	531,578	3 29	....
Value of all live stock,			$102,439,183	....	....

*The number reported is of fowls over 3 months old. The value is of all, old and young.
†Including Guinea fowls.

The total value of all live stock on farms, June 1, 1900, was $102,-439,183, of which 40.0 per cent. represents the value of horses; 28.4 per cent. that of dairy cows; 13.6 per cent. that of other neat cattle; 5.7 per cent. that of swine; 4.5 per cent. that of sheep; 4.4 per cent. that of poultry; and 3.4 per cent. that of all other live stock.

There were kept in towns and cities nearly one-twelfth as many dairy cows, nearly one-half as many horses two years old and over, almost two-thirds as many mules two years and over, and about one-seventh as many swine, as on farms.

No reports were secured of the value of live stock not on farms,

but it is probable that such animals have higher average values than those on farms. Allowing the same averages, however, the value of all live stock not on farms would be $21,392,693. Exclusive of poultry and bees not on farms, the total value of live stock in the State is, approximately, $123,831,876.

Changes in Live Stock on Farms.

The following table shows the changes since 1850 in the numbers of the most important domestic animals:

TABLE 15.—Number of Specified Domestic Animals on Farms: 1850 to 1900.

Year.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.*	Swine.
1900,	943,773	953,074	590,981	38,635	959,483	1,107,981
1890,	972,254	778,164	618,660	29,563	1,612,107	1,278,029
1880,	854,156	876,081	533,587	22,914	1,776,598	1,187,968
1870,	706,437	638,114	460,339	18,009	1,794,301	867,548
1860,	673,547	745,946	437,654	8,832	1,631,540	1,031,266
1850,	530,224	623,722	350,398	2,259	1,822,357	1,040,366

*Lambs not included.

Every decade since 1850 shows an increase in the number of dairy cows. The gain since 1850 is 78.0 per cent. and since 1890, 1.8 per cent. The number of other neat cattle has fluctuated from decade to decade, but shows an increase of 52.8 per cent. since 1850, and 22.3 per cent. since 1890. Except for a decrease in the last decade of 4.5 per cent. each decade since 1850 shows an increase in the number of horses reported. There were 17 times as many mules and asses reported in 1900 as in 1850, every decade showing an increase, that of the last being 30.7 per cent.

In the year 1850 more sheep were reported than at any later date. Every decade since 1870 records a decrease in numbers, that in the last being 40.5 per cent. Swine have fluctuated in number, the census of 1900 showing an increase of 6.5 per cent. since 1850, but a decrease of 13.3 per cent. since 1890.

The fact that in 1900 the enumerators were instructed to report no fowls under 3 months old, while in 1890 no such limitation was made, explains, to a great extent, the small increase in the number of chickens reported, and the decreases in the numbers of all other fowls. An increase in the number of eggs reported tends to confirm

this statement. Compared with the figures for 1890, the present census shows an increase of 1.7 per cent. in the numbers of other fowls: Ducks, 52.1 per cent.; turkeys, 51.5 per cent.; and geese, 42.9 per cent.

Animal Products.

Table 16 is a summarized statement of animal products on farms.

TABLE 16.—Quantities and Values of Specified Animal Products, and Values of Poultry Raised, Animals Sold, and Animals Slaughtered on Farms in 1899.

Products.	Unit of Measure.	Quantity.	Value.
Wool,	Pounds,	6,732,226	$1,381,689
Mohair and goat hair,	Pounds,	720	242
Milk,	Gallons,	*487,033,818	
Butter,	Pounds,	74,221,085	
Cheese,	Pounds,	857,167	
			†35,860,110
Eggs,	Dozens,	67,038,180	9,080,725
Poultry,			7,151,243
Honey,	Pounds,	2,526,202	
Wax,	Pounds,	61,302	
			305,292
Animals sold,			15,494,178
Animals slaughtered,			11,627,980
Total,			80,901,459

*Includes all milk produced, whether sold, consumed or made into butter or cheese.
†Includes the value of milk sold or consumed, and of butter and cheese made.

The value of all animal products of the State for 1899 was $80,901,459, of which 44.3 per cent. represents the value of dairy produce; 33.5 per cent. that of animals sold and animals slaughtered on farms; 20.1 per cent. that of poultry and eggs; 1.7 per cent. that of wool, mohair and goat hair; and 0.4 per cent. that of honey and wax.

Dairy Produce.

In 1899 the proprietors of 32,600 farms, or 14.5 per cent. of the farms of the State, derived their principal income from dairy produce. The production of milk in 1899 was 118,127,338 gallons greater than in 1889, a gain of 32.0 per cent. The amount of cheese made on farms increased 95.2 per cent. in the last decade, while the amount of butter made on farms decreased 3.4 per cent. in the same time, owing, largely, to the constantly increasing amount of milk and cream consumed in cities and to the transfer of butter making from the farm to the creamery.

Of the $35,860,110 given in Table 16 as the value of dairy pro-

duce, 75.4 per cent. or $27,053,424, represents the value of dairy products sold, and 24.6 per cent. or $8,806,686, the value of such products consumed on farms. Of the former amount, $17,274,430 was received from the sale of 171,045,659 gallons of milk; $9,466,575, from 51,309,833 pounds of butter; $249,779, from 537,445 gallons of cream, and $62,640, from 812,528 pounds of cheese.

Animals Sold and Animals Slaughtered.

The value of animals sold and animals slaughtered on farms is $27,122,158, or 18.0 per cent. of the gross farm income. Of all farmers reporting domestic animals, 180,508, or 83.9 per cent. reported animals slaughtered, the average value per farm being $64.42. Of all reporting domestic animals, 141,450 or 65.7 per cent. reported sales of live animals, the average value per farm being $109.54. In reporting the value of animals sold on farms the enumerators were instructed to secure from each operator a statement of the amount received from sales in 1899, less the amount paid for live stock in that year.

Poultry, Eggs, Wool and Honey and Wax.

Of the $16,231,968, given as the value of poultry and eggs, 55.9 per cent. represents the value of eggs produced, and 44.1 per cent. the value of poultry raised. In 1899, 16, 988,265 dozen more eggs were produced than in 1889, a gain of 33.9 per cent.

The amount of wool reported in 1900 was 4.5 per cent. greater than that reported in 1890. The average weight of fleeces increased from 5.3 pounds to 6.7 pounds, indicating an improvement in the grade of sheep kept.

Bradford county leads in the production of apiarian products, reporting 218,590 pounds of honey for 1899. For the State, 2,526,202 pounds of honey and 61,302 pounds of wax were reported in 1900, a gain in the last decade of 3.0 per cent. in honey, and 53.7 per cent. in wax.

Horses and Dairy Cows on Specified Classes of Farms.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses and dairy cows, the total number of these animals, and the average number per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

TABLE 17.—Horses and Dairy Cows on Specified Classes of Farms, June 1, 1900.

Classes.	Horses. Farms reporting.	Horses. Number.	Horses. Average per farm.	Dairy Cows. Farms reporting.	Dairy Cows. Number.	Dairy Cows. Average per farm.
Total,	195,983	590,981	3.0	200,036	943,773	4.7
White farmers,	195,472	589,754	3.0	199,668	942,193	4.7
Colored farmers,	511	1,227	2.4	368	1,580	4.3
Owners,*	140,535	402,309	2.9	144,750	629,121	4.3
Managers,	3,089	14,143	4.6	2,990	19,729	6.6
Cash tenants,	20,021	57,150	2.9	19,722	104,632	5.3
Share tenants,	32,338	117,379	3.6	32,574	190,291	5.8
Under 20 acres,	22,814	32,603	1.4	23,904	43,232	1.8
20 to 99 acres,	98,371	250,189	2.5	101,507	395,093	3.9
100 to 174 acres,	55,338	210,336	3.8	56,131	356,027	6.3
175 to 259 acres,	13,754	64,658	4.7	12,822	100,453	7.8
260 acres and over,	5,706	33,195	5.8	5,672	48,968	8.6
Hay and grain,	24,007	88,730	3.7	23,033	106,270	4.6
Vegetable,	5,956	14,864	2.5	4,505	11,658	2.6
Fruit,	2,821	6,137	2.2	2,258	5,301	2.4
Live stock,	67,599	205,483	3.0	70,338	277,374	3.9
Dairy produce,	31,125	96,699	3.1	32,600	284,921	8.7
Tobacco,	1,878	4,980	2.7	1,765	7,451	4.2
Flower and plant,	245	535	2.2	114	203	1.8
Miscellaneous,†	62,352	173,553	2.8	65,423	250,595	3.8

*Including "part owners" and "owners and tenants."
†Including sugar farms and nurseries.

Crops.

The following table gives the statistics of the principal crops of 1899.

TABLE 18.—Acreages, Quantities and Values of Principal Farm Crops in 1899.

Crops.	Acres.	Unit of Measure.	Quantity.	Value.
Corn,	1,480,833	Bushels,	51,869,780	$21,896,795
Wheat,	1,514,043	Bushels,	20,632,680	13,712,976
Oats,	1,173,847	Bushels,	37,242,810	11,093,893
Barley,	9,583	Bushels,	197,178	89,163
Rye,	310,048	Bushels,	3,944,750	2,070,847
Buckwheat,	249,840	Bushels,	3,922,980	1,945,860
Broom corn,	221	Pounds,	114,610	6,817
Kafir corn,	1	Bushels,	14	7
Flaxseed,	75	Bushels,	684	741
Clover seed,	....	Bushels,	37,276	163,522
Grass seed,	....	Bushels,	12,846	18,978
Hay and forage,	3,269,441	Tons,	4,020,388	37,514,779
Tobacco,	27,760	Pounds,	41,502,620	2,959,304
Hemp,	3	Pounds,	3,850	228
Hops,	13	Pounds,	13,710	1,451
Peanuts,	2	Bushels,	77	9[illegible]
Dry beans,	2,182	Bushels,	23,957	38,719
Dry peas,	482	Bushels,	6,363	7,618
Potatoes,	227,867	Bushels,	21,769,472	9,397,054
Sweet potatoes,	3,443	Bushels,	234,724	130,990
Onions,	1,505	Bushels,	347,806	216,646
Miscellaneous vegetables,	77,621	....	....	6,088,214
Maple sugar,	....	Pounds,	1,429,540	115,910
Maple sirup,	....	Gallons,	160,297	123,863
Sorghum cane,	105	Tons,	*21	71
Sorghum sirup,	....	Gallons,	6,514	3,090
Small fruits,	12,271	....	....	1,268,827
Grapes,	†7,852	Centals,	471,254	‡639,518
Orchard fruits,	†318,215	....	....	§7,976,464
Nuts,	....	....	....	91,149
Forest products,	....	....	....	6,481,181
Flowers and plants,	1,073	....	....	2,246,075
Seeds,	866	....	....	104,229
Nursery products,	3,201	....	....	541,012
Willows,	5	....	....	715
Miscellaneous,	10	....	....	47,316
Total,	8,692,408	....	....	126,994,141

*Sold as cane.
†Estimated from number of vines or trees.
‡Including value of raisins, wine, etc.
§Including value of cider, vinegar, etc.

Of the total value of crops in 1899, cereals, including Kafir corn, contributed 40.0 per cent.; hay and forage, 29.5 per cent.; vegetables, including potatoes, sweet potatoes and onions, 12.5 per cent.; fruits and nuts, 7.9 per cent.; forest products, 5.1 per cent.; flowers and plants, 1.8 per cent.; and all other products, 3.2 per cent.

The average values per acre of the several crops were as follows: Flowers and plants, $2,093.27; nursery products, $169.02; onions, $143.95; tobacco, $106.60; small fruits, $103.40; miscellaneous vegetables, $78.44; potatoes, $41.24; orchard fruits, $25.07; cereals, including Kafir corn, $10.72; hay and forage, $11.47. The crops yielding the greatest returns were grown upon the most highly cultivated

land, and required relatively large expenditures for labor and fertilizers.

Cereals.

Table 19 is a statement of the changes in cereal production since 1849.

TABLE 19.—Acreage and Production of Cereals: 1849 to 1899.

Part 1.—Acreage.

Year.*	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899,	9,583	249,840	1,480,833	1,173,847	310,048	1,514,043
1889,	20,950	210,488	1,252,399	1,310,197	336,041	1,318,472
1879,	23,592	246,199	1,373,270	1,237,593	398,465	1,445,384

*No statistics of acreage were secured prior to 1879.

Part 2.—Bushels Produced.

Year.	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899,	197,178	3,922,980	51,869,780	37,242,810	3,944,750	20,632,680
1889,	493,893	3,069,717	42,318,279	36,197,409	3,742,164	21,595,499
1879,	438,100	3,593,326	45,821,531	33,841,439	3,683,621	19,462,405
1869,	529,562	2,532,173	34,702,006	36,478,585	3,577,641	19,672,967
1859,	530,714	5,572,024	28,196,821	27,387,147	5,474,788	13,042,165
1849,	165,584	2,193,692	19,835,214	21,538,156	4,805,160	15,367,691

The total area under cereals in 1879 was 4,724,503 acres; in 1889, 4,448,547 acres; and in 1899, 4,738,194 acres. Of the total area under cereals in 1899, 32.0 per cent. was devoted to wheat; 31.2 per cent. to corn; 24.8 per cent. to oats; 6.5 per cent. to rye; 5.3 per cent. to buckwheat, and 0.2 per cent. to barley.

The area under wheat in 1899 was 14.8 per cent. greater than ten years before; that under corn, 18.2 per cent.; and that under buckwheat, 18.7 per cent. The area devoted to rye decreased 7.7 per cent. in the decade 1889-1899; that under oats, 10.4 per cent, and that under barley, 54.3 per cent.

The total number of bushels produced in 1849 was 63,905,497, and in 1899, 117, 810 178, a gain of 84.4 per cent. in fifty years.

The largest area under wheat was in the southeastern part of the State, Lancaster, York and Franklin counties each producing over 1,000,000 bushels in 1899. This section led also in the production of corn, Lancaster county reporting over 4,000,000 bushels, and York county, over 3,000,000 bushels. Oats were raised extensively in the eastern section, several counties showing yields of over 1,000,000

bushels each. Rye was also reported largely in the eastern part, while barley was more abundantly grown in the central portion of the State.

Hay and Forage.

In 1900, 207,706 farmers, or 92.6 per cent. of the total number, reported hay and forage crops, of which, exclusive of corn-stalks and corn strippings, they obtained an average yield of 1.2 tons per acre. The acreage in hay and forage in 1899 was 1.6 per cent. less than ten years before.

In 1899 the acreages and yields of the various kinds of hay and forage were as follows: Clover, 293,683 acres and 336,072 tons; other tame and cultivated grasses, 2,873,126 acres and 3,174,110 tons; grains cut green for hay, 44,729 acres and 57,821 tons; forage crops, 45,366 acres and 181,923 tons, and other kinds, 231,961 acres and 271,-362 tons.

In Table 18 the production of cornstalks and corn strippings is included under "hay and forage" but the acreage is included under "corn," as the forage secured was only an incidental product of the corn crop.

Orchard Fruits.

The changes in orchard fruits since 1890 are shown in the following table:

TABLE 20.—Orchard Trees and Fruits: 1890 and 1900.

Fruits.	Number of Trees. 1900.	Number of Trees. 1890.	Bushels of Fruit. 1899.	Bushels of Fruit. 1889.
Apples,	11,774,211	9,097,700	24,060,651	7,552,710
Apricots,	10,044	5,913	1,634	163
Cherries,	956,273	465,867	474,910	60,571
Peaches,	3,521,930	1,146,342	143,464	117,151
Pears,	815,349	325,062	434,177	144,534
Plums and prunes,	707,512	152,533	100,210	7,899

The total number of fruit trees in 1890 was 11,193,417, while in 1900 there were 17,844,269—an increase of 6,650,852 or 59.4 per cent. in the decade. The number of plum and prune trees reported in 1900 was nearly five times as great as in 1890, and the number of peach, pear and cherry trees were approximately three times as great. The number of apricot trees increased 69.9 per cent. and that of apple trees, 29.4 per cent. The increases were quite evenly distributed throughout the State.

Of the total number in 1900, 66.0 per cent. were apple trees; 19.7 per cent. peach trees; 5.4 per cent. cherry trees; 4.6 per cent. pear trees: 4.3 per cent. apricot, plum, prune, and unclassified trees; the latter class, which is not included in the table, numbered 58,950 and yielded 21,778 bushels of fruits. The value of orchard products given in Table 18 includes the value of 504,472 barrels of cider, 110,-324 barrels of vinegar and 938,810 pounds of dried and evaporated fruits. Comparisons of fruit yields or values, when made by decades only, are of little value, as the yield of any given year depends upon the season.

Small Fruits.

The total area used in the cultivation of small fruits in 1899 was 12,271 acres, distributed among 50,937 farms, an average of 0.24 acre per farm. Of the total area, 5,667 areas, yielding 10,179,430 quarts, were devoted to strawberries. These berries were grown generally throughout the State, but the southeastern counties of York, Lancaster, Berks and Chester, together with the western counties of Allegheny and Erie, report 38.0 per cent. of the product and 36.4 per cent. of the acreage. The acreages and productions of the other berries were as follows: Raspberries and Logan berries, 3,938 acres and 5,360,530 quarts; blackberries and dewberries, 1,383 acres and 1,995,070 quarts; currants, 716 acres and 1,031,870 quarts; gooseberries, 267 acres and 366,930 quarts; and other small fruits, 300 acres and 326,730 quarts.

Vegetables.

The total area used in the cultivation of vegetables, including potatoes, sweet potatoes and onions, in 1899 was 310,436 acres. Of this area 73.4 per cent. was devoted to potatoes, 25.0 per cent. to miscellaneous vegetables, 1.1 per cent. to sweet potatoes, and 0.5 per cent. to onions. Potatoes were extensively raised throughout the State, 227,867 acres being devoted to them, and yielding 21,769,472 bushels, an average of 95.5 bushels per acre.

The total area used in the cultivation of miscellaneous vegetables was 77,621 acres, of which the products of 42,041 acres were not reported in detail. Of the remaining 35,580 acres, 12,879 were devoted to sweet corn; 10,851, to cabbages; 6,089, to tomatoes; 785, to turnips; 751, to muskmelons; 719, to cucumbers; 618, to watermelons; 596, to asparagus; 561, to celery, and 1,698 to other vegetables.

Tobacco.

Though tobacco was cultivated in Pennsylvania as early as 1689, its production was not reported with any degree of care until 1840.

In that year the total production was 325,018 pounds, and with the exception of a decrease in the decade from 1880 to 1890 the production has steadily and rapidly increased. The increase in production for the last decade was 43.3 per cent. and that in acreage, 3.0 per cent.

The present census shows that tobacco was grown in 1899 by 9,621 farmers, who obtained from 27,760 acres a yield of 41,502,620 pounds, or an average of 1,495 pounds per acre.

The most important tobacco region in the State is the southeastern part, where Lancaster and York counties reported a total of 34,413,650 pounds. In Lancaster county, which was the leading tobacco county of the country in 1889, there were 5,809 farmers, June 1,1900, who reported a total of 18,025 acres, upon which they raised 28,246,160 pounds, or 68.1 per cent. of the State total. The value of the product in this county was $1,991,446. In the northern part of the State, Tiega county reported 2,812,330 pounds; Bradford county, 1,693,820 pounds, and Clinton county, 1,221,730 pounds. Other counties producing over 200,000 pounds, are Chester, Lebanon and Lycoming.

Sorghum Cane.

The present census shows that in 1899, 233 farmers raised 105 acres of sorghum cane, from which they sold 21 tons of cane for $71, and from the remaining product manufactured 6,514 gallons of sirup, valued at $3,090. This was a decrease in acreage since 1889 of 78.5 per cent. The sorghum crop reached its highest point in 1869, with a production of 213,373 gallons of sirup.

Floriculture.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 1,073 acres, and the value of the products sold therefrom was $2,246,075. These flowers and plants were grown by 1,093 farmers and florists, of whom 734 made commercial floriculture their principal business. These 734 proprietors reported a glass surface of 8,811,711 square feet. They had invested in the aggregate $6,894,985, of which $3,705,528 represents the value of land, and of improvements other than buildings; $2,952,280, the value of buildings; $179,445, that of implements; and $57,732, that of live stock. Their sales of flowers and plants amounted to $2,043,124, and of other products, to $171,319. They expended for labor $513,677, and for fertilizers, $41,537. Including the value of products fed to live stock, the average gross income per farm reporting was $3,036.

In addition to the 734 principal florists' establishments, 2,969 farms

and market gardens made use of glass in the propagation of flowers, plants or vegetables. They had an area under glass of 5,210,827 square feet making with the 6,608,783 square feet belonging to the florists' establishments, a total of 11,819,610 square feet of land under glass.

Nursery Products.

The total value of nursery stock sold in 1899 was $541,032, reported by the operators of 280 farms and nurseries. Of this number, 95 derived their principal income from the nursery business. They had 5,801 acres of land, valued at $688,035; buildings worth $256,755; implements and machinery worth $21,775; and live stock worth $23,604. Their sales of nursery products amounted to $457,820, and sales of other products to $15,765. They expended for labor $150,365, and for fertilizers, $9,050. Including value of products fed to live stock, the average gross income per farm reporting was $5,421.

Labor and Fertilizers.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $16,617,730, an average of $74 per farm. The average was highest on the most intensively cultivated farms, being $1,583 for nurseries, $700 for florists' establishments, $141 for vegetable farms, $126 for tobacco farms, $113 for dairy farms, $89 for hay and grain farms, $88 for fruit farms, $70 for sugar farms, and $50 for live-stock farms. "Managers" expended an average per farm of $334; "cash tenants," $90; "share tenants," $87; and "owners," $62. White farmers expended $74 per farm and colored farmers, $45.

Fertilizers purchased in 1899 cost $4,685,920, an average of $21 per farm, and an increase since 1890 of 38.5 per cent. The average was $95 for nurseries, $57 for florists' establishments, $46 for vegetable farms, $33 for tobacco farms, $25 for hay and grain farms, $22 for dairy farms, $18 for fruit farms, $16, for live-stock farms, and $12 for sugar farms.

IRRIGATION STATISTICS.

Irrigation began more than one hundred years ago in Berks county, where small areas of bottom lands were artificially flooded as early as 1800. Until recent years the practice of irrigation was confined to narrow and comparatively level strips of land edging the streams upon which water could be diverted easily and at slight expense. The hilly nature of the country in which irrigation was first intro-

duced precluded the possibility of any considerable extension of irrigated areas.

The acreage artificially watered in 1899 was devoted principally to hay, more than 93 per cent. of the total area irrigated being under this crop. A large part of this acreage was reported from Monroe, Northampton, Lehigh, Bucks, Berks and Lancaster counties in the southeastern part of the State. In 1899 the acreage of hay irrigated was 758, and the value of the crop was $17,920, or $23.64 per acre.

The value of irrigation in truck farming as an assurance against loss by drouth has been demonstrated in several counties of the State, and the reports from irrigated farms show a very large income per acre. The methods of irrigation on these farms vary greatly, and the cost is much higher than on farms where hay is the only crop irrigated.

The water is generally pumped from driven wells by steam power or windmills. In the vicinity of large cities the farmers occasionally use city water. Notwithstanding the heavy original cost of engines, pumps, pipes, etc., in nearly every instance the value of the irrigated crop reported was equal to or exceeded the first cost. In 1899 the acreage value per acre of the products derived from irrigated land devoted to truck farming, was $330.43.

The following table shows the number of irrigators, and acreage irrigated, with cost of construction of irrigation systems, and value of irrigated products in 1899.

TABLE A.—Number of Irrigators, Acreage Irrigated, and Cost of Construction of Irrigation Systems, With Acreage and Value of Irrigated Crops.

Counties.	Number of irrigators.	Acreage irrigated.	Cost of construction of irrigation systems.	Irrigated Crops.		
				Acreage.	Value. Total.	Value. Average per acre.
The State,	134	814	$15,627	804	$33,220	$41 32
Berks,	37	214	$470	204	$4,369	$21 42
Lancaster,	20	189	1,707	189	5,884	31 13
Monroe,	8	73	7,020	73	7,600	104 11
Northampton,	41	214	2,015	214	7,665	35 82
Other counties,	28	124	4,415	124	7,702	62 11

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